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IN EXCHANGE.
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Ophthalmic Hospital Reports.

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CASE

OF

EPITHELIAL CANCER OF ŒSOPHAGUS

IN WHICH GASTROTOMY WAS PERFORMED.

By S. O. HABERSHON, M.D.

Walter H——, æt. 47, was admitted into Guy's Hospital October 8th, 1857, under my care. He had resided at Tunbridge Wells as a stableman, was of ordinary stature, light complexion, and moderately nourished. He stated, that for sixteen years he had had winter cough, but that he had never had dropsy. On admission there was considerable dyspnœa; the lips purplish; the pulse compressible, but regular; the chest was resonant on percussion, and the respiratory murmur indistinct; distant prolonged expiratory murmur was everywhere audible, with some sibilant râle; the voice also indistinct, and tactile vibration diminished. The heart-sounds were regular and normal; the expectoration frothy and moderately abundant. The abdomen was moderately full and rounded; the liver not felt to be enlarged; the legs were not anasarcous, neither did the urine contain albumen. There was a small hard gland felt about the anterior margin and upper part of the sterno-mastoid muscle. He was ordered the julep of acetate of ammonia, with nitric ether and compound tincture of camphor, squill and blue pill night and morning; and meat diet.

After he had been in the hospital for a short time, he began to complain of severe pain in the throat during coughing; but,

on carefully examining the part, nothing could be perceived. In a few weeks pain was also produced in swallowing, especially when solids were taken, the cough continuing unrelieved. On December 14th, he continued to suffer severely, and became more anæmic; the countenance was expressive of great distress, and the mind irritable; deglutition had become very difficult, so that he could only take fluid forms of food, and some stimulant. The cough also was very troublesome, producing very severe pain in the throat; it was violent, and small drops of blood were spirted out in the act of coughing; the expectoration was thin and watery. The chest continued resonant; respiration very feeble, on the left side indistinct, and the expiratory murmur prolonged; the larynx was free in its movements. Nothing could be seen in the throat, except slight œdema and redness towards the right side. The gland at the angle of the jaw remained of the same size; the pulse was compressible; the tongue clean; the bowels confined. Various means were tried, as conium and carbonate soda, with hydrocyanic acid, steel, &c. The bowels were acted upon by colocynth and henbane, by magnesia mixture, or by injections. Counter-irritation was applied to the throat—hot water fomentation, or cataplasms, blisters, &c. The inhalation of steam afforded some relief, but still more the smoking of stramonium leaves. Tincture of aconite, applied externally, was also of some benefit. My friend and colleague, Mr. Cooper Forster, examined the throat for me, but could not detect any cause of obstruction. The patient continued during January and February without any improvement, the emaciation increased, and both respiration and deglutition became more difficult, especially the latter. Morphia occasionally given, and the stramonium inhaled, afforded partial relief. On again examining the throat, Mr. Forster felt below the epiglottis, towards the right side, a rounded tumour, which was evidently obstructing the commencement of the œsophagus, and he believed its surface was ulcerated. The respiration, although noisy and accompanied with a loud inspiratory sound, was not hurried, and sufficient air appeared to enter the larynx. The propriety of performing tracheotomy was discussed, but it was decided that no benefit would be likely to accrue from it. The examination of the growth in the throat was followed by temporary relief; and the patient was able, for

three or four days, to swallow solid food. The stramonium and other means of relief, were continued; and nourishment was given in any form that he could take it. On March 1st the emaciation had very much increased. During inspiration a loud noise was produced in the throat; and this sound had for some weeks been increasing in intensity, so that he had been unable to sleep for several nights, on account of the "roaring," as he termed it. His voice had become more feeble, but the cough had almost ceased; he could only swallow fluids, and those very slowly; his nourishment latterly had consisted of milk and rum, with eggs. Deglutition was much relieved for two or three days by two small blisters applied on either side the larynx; but it again became so difficult, that nutrient injections were resorted to. On February 22d, these injections, by allowing the throat to rest, enabled him in a few days to swallow with more comfort. The pulse had become very compressible and small; the bowels occasionally constipated.—March 2d. The respiration became more difficult, and Mr. Stocker had tracheotomy performed in the night. The incision was made as low as possible, but the trachea appeared flattened from behind, and the patient could not bear the tracheal tube inserted; when it was attempted he appeared to be quite incapable of breathing. The operation did not afford relief; and a deep-toned rhonchus could be heard in the lungs. There was no congestion of the face; the pulse very compressible; cough slight; he was able to get down his rum and milk, and some blanc-mange, &c. On the 9th he was breathing more comfortably; the opening in the throat was patent, and thin pus covered the red margins of the wound; there was also less noise on inspiration.—24th. The emaciation and prostration of strength increased; his bones appeared barely covered with thin skin, and the face expressive of starvation. He said "he was famished." He endeavoured to relieve his distressing thirst by moistening the mouth; but for four days he had not been able to swallow a drop of fluid. The attempt to swallow at my request was preceded by much hesitation and preparation, and was followed by a paroxysm of severe coughing. The expectoration had changed in character, and had become muco-purulent. On examining the chest sibilant râles were everywhere faintly audible. There was no dulness on per-

cussion, but preternatural resonance. The voice was very feeble, and scarcely audible; the pulse slow and very compressible; the tongue clean; the larynx was moveable; the gland at the angle of the jaw as before; the opening in the skin made during tracheotomy remained open, and the skin was undermined, there being evidently no power to repair the wound. The abdomen was exceedingly contracted, the pulsation of the aorta being visible, and the arteries most distinctly traceable. There was no evidence of enlargement of the liver, or of disease of the abdominal viscera. He complained of pain towards the right side, and tied a handkerchief firmly around him to relieve the sense of hunger. The skin was dry. He passed about a pint and a half of urine during the day. The sleep was tolerable; the mind clear and active. Nutrient injections of beef-tea, eggs and rum, thickened, if possible, with flour, had been given, at first four times and then six times a day. Milk also was ordered, and ♏v of tincture of opium to be added to each injection. On the 25th he appeared to be sinking, and the rectum ejected the enemata almost at once. His hands were cold; but he complained of a sense of heat. It now became a question, whether life was to be allowed gradually to die out, or an attempt to be made by any other means for the introduction of food; the patient appeared to have chronic bronchitis, with epithelial cancer at the commencement of the œsophagus, possibly extending into the trachea, and death threatened from inanition. Three modes of relief suggested themselves—1st, the forcible introduction of an œsophageal tube; 2d, opening the œsophagus in the neck; and 3d, opening the stomach. In reference to the first, there was evidence of a growth at the commencement of the œsophagus; and the trachea appeared partially compressed, as shown in the operation of tracheotomy. The disease in the throat was probably of the form of epithelial cancer, and the passage of a bougie must have been constantly repeated. The great irritation and coughing produced by attempting to swallow, showed that the epiglottis was extensively ulcerated; *or* that there was a communication between the œsophagus and trachea, which would render the passage of a bougie very dangerous. In some cases of cancer of the œsophagus, a bougie has been

passed into the pleura, and led to speedy death,—and probably the passage of a bougie could not have been effected,—this decided against the first proceeding. As to the second,—opening the œsophagus—the most frequent seat of cancer in that tube being opposite to the root of the lung, about the third dorsal vertebra, and consequently beneath the position at which the canal could be opened, would have made the operation a very formidable, dangerous and useless one. In reference to the third,—opening the stomach—this alone appeared to be the operation which could possibly relieve the patient. Wounds of the stomach, as that of Alexis St. Martin, the cases recorded by Mr. South, those by Dr. Murchison, &c., showed that life could be continued after fistulous communication had been thus made. The operations on the lower animals proved that it could be performed with some probability of success; such an operation would give a chance of prolonged life, where death was certain; and where the peritoneum was healthy, there was less danger than in abnormal conditions of that membrane. If life were prolonged only for a short time, and food introduced, there would be relief to the distressing thirst and the fearful sense of starvation: and lastly, it was evident that the patient was dying from inanition rather than from the disease, nutrient enemata being refused. On the other hand, however, I felt that the disease was probably of a cancerous character, and would sooner or later terminate life; that the operation was a hazardous and uncertain one; and that life might possibly be continued for a few days by a small portion of the injection being retained. After carefully weighing these facts, I asked the assistance of my colleague, Mr. Cooper Forster, and if he considered the operation of opening the stomach through the anterior abdominal parietes, for the purpose of introducing food, a feasible and warrantable one I decided that it should be attempted. The operation was accordingly performed by that gentleman, the steps of which he will describe; but the skill with which it was executed, the scientific coolness and care displayed, and the manner in which it was brought to a successful termination, all who witnessed the operation can confirm.—March 26th. The operation took place about half-past 2 p.m., and was borne

without a movement on the part of the patient. The pulse, which before the operation was 62, and exceedingly compressible, rose to 116. Six drachms of milk with part of an egg were introduced through an elastic tube into the stomach. About twenty minutes past 3, about two ounces more milk and egg were introduced; he complained of feeling a sense of heat, but appeared comfortable. He was now removed to bed. At 4 p.m. the pulse was 120 and still very feeble; it was decided to introduce every half hour, if the patient were awake, two ounces of milk and egg, and every second time two drachms of rum with it. At 9 p.m. he was comfortable; there had been slight pain in the left side; the pulse was fuller, 124; the skin less parched; and he had slept occasionally for a short time. Messrs. Greenwood, Gayleard, Owen, and Tuck, kindly volunteered to remain with him in rotation, and their assiduous care and kind attention is sincerely acknowledged. During the night he had four hours of sleep; he passed urine, and there were three slight watery evacuations from the bowels.—27th. About 10 a.m. he coughed violently, and the contents of the stomach were forcibly ejected through the wound. His pulse continued 120. At 1 p.m. he was cheerful, his eyes more bright, his voice stronger, the skin less parched, his tongue moist, thirst and the sense of starvation relieved; he had pain in the left side; the pulse 120, and very compressible; his hands were cold, feet and legs warm; the coldness of the hands was very marked for several days before the operation. The operation had evidently mitigated his suffering. At 1·30 p.m. half an ounce of rum, with sugar, and an ounce and a half of water, and fifteen minims of lemon-juice were given. The stomach received it well, contracting upon the tube. He said that it produced a comfortable sense of warmth throughout the abdomen. At 3·30 the pulse was firmer and fuller than at 1 o'clock, and the hands warmer. Since the operation, during the twenty-four hours, he had six eggs, beaten up in twelve ounces of milk, given in small divided doses, with four ounces of rum. Milk and egg, or beef tea thickened with flour, were ordered every half hour, and occasionally half an ounce of rum, as just mentioned. At 8·30 p.m. faintness came on, the face became cold and perspiring; pulse 136, and scarcely to be felt. The

stomach appeared to have lost its power of contracting on the food introduced.

Stimulants were ordered to be given repeatedly and freely, with nourishment as before; and two or three times, as a stimulant, ♏xx of tincture of sesquichloride of iron. During the night he was evidently sinking, the pulse sometimes became scarcely perceptible, but rallied after stimulants were introduced. On the 28th he slept for a short time about 10 a.m., and expressed himself as comfortable; but gradually became unconscious, and died at 10·45, rather more than forty-four hours after the operation.

Inspection was made twenty-eight hours after death. The body was extremely emaciated. The head was not examined. At the lower part of the neck, immediately above the sternum, was the wound made in tracheotomy, gaping and undermined, and on the trachea a few drops of pus. At the left hypochondrium was the opening made by the operation of gastrotomy, also enlarged by the plug which had been introduced a few hours before death. (Plate I.) The mouth and soft palate were healthy, also the epiglottis. At the posterior surface of the cricoid cartilage there was a growth connected with the mucous membrane (Plate IV), about a quarter of an inch in elevation, and extending from side to side, soft and slightly injected; passing downwards, there was irregular ulceration, and towards the trachea destruction of all the coats of the œsophagus; on either side and below, the ulcer was bounded by a sharp undermined edge. The cellular tissue of the trachea and its muscular fibres were destroyed for about half an inch; the mucous membrane was bare, and perforated by a small opening about one sixteenth of an inch in diameter, so that fluid could pass from the œsophagus into the trachea; below the ulcerated surface in the œsophagus the canal was much contracted by infiltration into the surface of the mucous membrane; the passage was so much diminished at this part that a probe could only be passed after death, and it was probably quite impervious to fluids during life. The constriction *was situated at the level of the first bone of the sternum.* The rest of the œsophagus was healthy. One or two glands in the neck were infiltrated and diseased, but none of the mediastinal or other glands. The rima glottidis was free; the vocal cords and aryteno-

epiglottidean folds quite healthy; so also the trachea. The bronchi contained thick tenacious mucus. The pleura on the left side was healthy; on the right, there were general, but not firm adhesions. The lungs were both much distended with air, pale, emphysematous, and covered the heart. At the right apex the lung-tissue was puckered; there were numerous lobules of iron-gray consolidation, with intervening crepitant lung, but no disorganization. The lower lobe of the right lung afforded a beautiful specimen of emphysema, but there were numerous gray tubercles studded in small clusters; they were non-cancerous. The lower lobe of the left lung was much congested, and one or two lobules were softened and breaking down, from acute changes, probably a very short time before death. There was no enlargement of the bronchial glands. In front of the surface of the heart was a small collection of pus, only a few drops, apparently from the inflammation of small gland. The pericardium and heart were healthy, the heart contracted and firm. On opening the abdomen, the intestines were found contracted; *the peritoneum was healthy; no inflammation, effusion of lymph or serum, or diminution of its normal smoothness could be detected.* The stomach was partially distended; it was situated lower than usual, and its anterior surface was looped up to the opening in the anterior abdominal parietes made by Mr. Forster at the linea semilunaris. (Plate II.) The mucous membrane of the stomach was pale, slightly injected at the opening. (Plate III.) On gently drawing aside the stomach at the opening, the opposed serous surfaces were found slightly adhering. The small intestine was healthy throughout, but atrophied; the food introduced had only passed four feet down the intestine; below that point the intestine was exceedingly small. The lower part of the ileum was healthy. In the colon there were several patches of congested mucous membrane. The gall-bladder was distended, the liver healthy, so also the kidneys; the spleen was very small. There was no evidence of any cancerous disease affecting any part except the œsophagus and one or two adjoining glands.

Remarks.—It is probable that chronic disease of the right apex had existed for a long time, so also the emphysema. Other miliary tubercles were perhaps of recent deposition. The

lobular consolidation and congestion of some parts of the left lower lobe of the lung were evidently only of very brief duration. As to the cause of the cancerous disease we have no evidence; it was probably of about six months' duration; its existence with chronic disease of the lung is a fact of some pathological interest. The microscopical examination of the growth in the neck presented the form of cell-growth common in epithelial cancer of that part.

In reference to the diagnosis in this case, it was evident at the time of admission that the patient had chronic disease; he had had cough for fifteen years; there was, however, no evidence of serious obstruction to the heart or to the portal circulation; the dysphagia was then a new symptom. The examination of the chest did not give any indication of phthisis, the respiration was exceedingly feeble at the apices, but there was no dulness on percussion, and the voice was diminished rather than increased in resonance; at the bases the expiratory murmur was prolonged; it appeared probable that there was no marked consolidation of the lung, but rather that the feebleness of the respiratory act arose from emphysema. The question arose, whether there was any pressure on the right bronchus; but of this there was no proof; the respiration at the right base was as strong as at the left, and there was no increase of resonance at the right apex, though the respiration was less distinct. As to the cause of the dysphagia, it was naturally suggested, whether it was a case of phthisis, in which the principal disease manifested itself in the throat, by ulceration of the epiglottis. I have several times observed in severe ulceration of the epiglottis very severe dysphagia and the condition mistaken for obstructed œsophagus. Few, however, would have had that idea in this case, for there was wanting at the early stage the raucedo of phthisis; and the difficulty in swallowing was evidently at a later stage of the process than in ulceration of the epiglottis: there the attempt to swallow is scarcely commenced before the food is ejected, often through the nares; here, it passed beyond, there was no such ejection of food, but rather severe pain, and that extending to the ears. The blood also which was spirted out during coughing was not as we observe it in ulcerated larynx, but was evidently from the pharynx. Sub-

sequently a tumour could be felt at the commencement of the œsophagus. The emaciation was not that of simple phthisis: there we generally have a rounded abdomen, and often more or less diarrhœa; here there was uniform constipation and collapsed abdomen. There was no evidence of syphilis to account for the affection of the throat, nor of aneurism. It was presumed that the affection of the pharynx and œsophagus was of the form of epithelial cancer; the enlarged gland in the neck confirmed this idea, and there was nothing to indicate any such disease of other viscera. As to the prognosis, that was from the first unfavorable, but it was not for several weeks anticipated that such serious disease of the throat would present itself; all idea was then given up of ultimate recovery. In the *treatment*, the object was to relieve the irritation of the bronchi and the engorgement of the portal system; and to strengthen the patient, meat diet was given. The excreting organs and glands were acted on by squill and blue pill, by purgatives, &c. The spasmodic contraction of the bronchi relieved by conium, alkalies, hydrocyanic acid, stramonium. These ends our remedies partly effected, others were beyond our reach. The pain produced by swallowing and coughing was most distressing, and sometimes kept the patient awake for several nights. Inhalation of steam was a relief, so also the smoking of the leaves of stramony. The application of nitrate of silver aggravated the distress. Most benefit was derived from the application of small blisters on either side of the throat; tincture of aconite also applied externally was of greater benefit than chloroform; morphia administered internally produced transient composure; however, all these means, of value in relieving suffering, could not check the progress of the disease. When it became necessary to resort to nutrient injections, life was fast ebbing away. It may be a question as to what is most effective in this case; beef-tea thickened with flour, an egg, and a small quantity of rum were used. Dr. Gull suggested the propriety of using pepsine mixed with the fluid, and since the rectum is incapable of rendering the aliment in a condition ready for absorption, it may be well deserving of trial. The longest period in which I have known a patient nourished by injections alone, was in a case mentioned by Dr. Barlow, in which for

seventy days food was administered only in this manner. In this patient the rectum much more quickly refused injections. All other means of affording relief being taken away, as stated in describing the case, I was brought to the consideration of gastrotomy. In my work on Diseases of the Alimentary Canal, I have ventured to suggest this operation in impending starvation, in cases of perforation or communication between the œsophagus and trachea, where deglutition is sometimes impossible. Death in these cases sometimes takes place simply from inanition. In this instance, it was well known that there was incurable disease, and that any operation which might be performed would only be palliative. It was submitted to the patient, that such an operation might be quickly fatal, or prolong his life for a few weeks; even with such a slight hope he most readily assented, so terrible was the sense of starvation and of thirst. These symptoms were relieved, and the horrors of such a death partially mitigated. In the treatment of the case after the stomach had been opened, it might have been well to have repeated nutrient injections by the rectum, and to have given food less frequently, although the quantity introduced at each time was only two ounces. There was fear lest the operation might suddenly terminate the flickering flame of life, lest no rallying should take place; and afterwards, lest the sutures give way, and the contents of the stomach be freely extravasated into the peritoneum. After twenty-four hours faintness came on; the patient was evidently sinking, and any treatment would have been alike ineffective. Stimulants were given very freely, and at each time were followed by a slight revival in the action of the heart. There appeared to be nothing to call for the action of opium; but, at last, a small quantity of tincture of iron was administered, as being one of the most powerful stimulants. The consideration of the complete particulars of the case lead to the conviction, that if the operation had been performed earlier more permanent benefit might have accrued. It was done with comparatively trifling addition to the sufferings of the patient; it was effected with ease, without collapse or peritonitis; the thirst and sense of starvation were relieved in a degree which were scarcely anticipated. In cases where starvation equally

advanced as in this case has been witnessed, death has taken place as quickly; and it is probable that had the operation not been performed, death might have taken place as speedily, if not more so. The patient would certainly have been deprived of the relief which for twenty-four hours he experienced. Under these circumstances it is urged, that if a favorable case be presented, the same operation be performed, but without waiting till life is almost extinct.

DESCRIPTION

OF THE

OPERATION OF GASTROTOMY.

By J. COOPER FORSTER.

I was requested by my friend and colleague, Dr. Habershon, to see a patient under his care in Philip Ward, who was suffering from an epithelial cancer of the œsophagus, with a view of affording him some relief to the fearful state of starvation to which he had been reduced in consequence of inability to take nourishment by the natural channel. Dr. Habershon suggested the propriety of opening the stomach to pour food and drink directly into that viscus, the rectum having refused to retain nutrient enemata, and nothing but death of a most painful character presenting itself to the patient.

That a direct opening into the stomach, or "gastro-cutaneous fistula," might be formed, and the patient live some years, was certain. In an elaborate paper read at the Medical and Chirurgical Society last year by Dr. Murchison several cases of this kind were quoted, and I am indebted to that gentleman for the reference to them, in which patients with mechanical injuries (they amount to seven in number), the class most nearly allied to that with which this case is related, have had permanent fistula and lived.[1] There could therefore be no doubt that an operation such as was proposed might be attended with a similarly fortunate result, provided the patient's powers were not so far

[1] A case is mentioned in the 'Journal de Médécine et Chirurgie,' par Corvisart, Leroux, &c., in which a peasant received a wound with a cutlass which opened the stomach, and a fistula was formed through which food passed.

depressed that death must result from exhaustion without the operation.

Fearful as the proceeding appeared to me, and exceedingly doubtful whether death might not result from surgical interference, I did not hesitate, after due consideration, to come to the conclusion that an operation might be performed with at least the view of affording temporary relief to the poor sufferer. To pass a stomach-pump tube down the natural passage might, I thought, cause sudden death; and even if done once, could not be repeated as frequently as necessary to admit of a due supply of nourishment; and indeed no one who had carefully examined this case or seen others of a like character would for one moment have thought of hazarding the life of the patient by such a proceeding. A case has been related to me where a deceased surgeon of great notoriety passed a tube through a diseased mass, similar to that in this patient, into the pleura, and poured half a pint of beef tea into that cavity, and I felt therefore that the passage of a tube down the œsophagus was not warrantable. The operation of œsophagotomy next presented itself to my mind, but remembering the probability of an extension of the disease in the pharynx into the œsophagus as low down as the spot in the neck where the operation would be performed, the difficulty of its performance from the great depth from the surface at which the œsophagus is placed, the propinquity of the great vessels, and the inability to keep the opening patent afterwards, made me determine at once that this plan of relief was not feasible. I therefore came to the conclusion that the suggestion of Dr. Habershon, viz., of directly opening the stomach, was the only means to be adopted. Upon duly representing to the poor man the dangers of the operation, and the certainty of its only affording him temporary relief, he gladly caught at the idea, and wished any plan to be adopted that might relieve him from his present fearful agony occasioned by the pangs of hunger and thirst.

I examined him, with a view of determining the several steps of so important an operation. The abdomen was found as thin as could possibly be conceived, the anterior parietes apparently lying upon the posterior; the whole length of the abdominal aorta and the two iliac arteries could be felt pulsating most

distinctly; percussion yielded nothing but a universal dull sound; little therefore of a positive character was elicited as to the position of the viscera, and I was compelled to pass in review in my own mind the various steps of the proposed proceeding. The opinion of my surgical colleagues was obtained as to the feasibility and propriety of the operation; they all most cordially agreed with Dr. Habershon and myself in the advisability of performing it, and assisted me in the various steps. Sanctioned by the presence of the medical and surgical staff, I performed the operation, there being no experience in British surgery to guide me.

Accordingly, on the 26th March, at 2 p.m., the man was placed on his back in bed, which was raised on a table, fearing to move him, lest syncope of an alarming character might occur, remembering that no stimulant could be administered by the mouth. His pulse was very feeble; he was perfectly sensible, cool, and collected, and smiled assent to the expected relief; chloroform was not administered for several reasons, and the patient did not desire it. I stood on his right side and made an incision through the skin and fascia with an ordinary scalpel over the course of the left linea semilunaris, commencing at the cartilages opposite the intercostal space between the eighth and ninth ribs, and carried the incision downwards to the extent of three inches and a half; the tendinous portion of the oblique abdominal muscles was next divided, and the outer edge of the rectus exposed: the next step was to take care and avoid the hæmorrhage likely to arise from dividing the intercostal arteries, which were seen lying on the transversalis muscle, and though generally small in this part, might give rise to troublesome bleeding, which would render obscure the appearance of the tissues; one vessel was therefore tied. The divided structures were now held apart by retractors, and an incision made carefully through the transversalis muscle, until the fascia lining it was seen; this was much wasted, so that although carefully wishing to separate it from the peritoneum beneath, I was unable to accomplish it entirely, and thus in attempting to pass the director underneath the fascia and superficial to the peritoneum, a small opening was made at the lower part of the wound in the latter structure. Taking advantage of the opening thus made, an ordinary director was passed through it and upwards towards

the ribs, and the peritoneum divided the whole length of the wound, thus exposing the viscus for which I was in search. A small portion of the left lobe of the liver was distinctly seen at the upper angle of the wound, and under it the stomach, which also extended into the left hypochondrium; the greater and lesser curvatures of the organ, in consequence of its small size, with a very thin omentum, quite transparent, attached to it, were also distinctly to be traced, which, coupled with the position of the viscus beneath the liver, and the thickened and peculiarly creamy white appearance of its surface, plainly distinguished it as the stomach; I therefore, with a tenaculum, carefully hooked it up to the abdominal parieties, passing the instrument through its anterior wall in a transverse direction, from left to right, and as much towards the left side as possible; taking care, however, not to drag it away from its natural position. A curved needle, armed with a strong silk ligature, was then passed through the walls of the stomach, and sowed to the parietes of the abdomen by an uninterrupted suture. After the first two stitches had been put in, I opened the organ by dividing that part of it included between the two portions of the tenaculum, and thus freed that instrument, the incision being about three quarters of an inch long, a few drops of blood passing into the stomach. I then continued to sew the divided edges of the viscus carefully to the abdominal parietes as I had commenced; in doing so the needle was passed one third of an inch within the stomach, so as to get a good hold, and then stitched with care to the skin, including as much as possible also of the abdominal parietes. The opening in the stomach was enlarged slightly, so as to get it of sufficient calibre to admit the end of the feeding tube. As the opening in the stomach was much less than the external wound, the remaining part of this was brought together with an uninterrupted suture, the divided peritoneum being left untouched. The greatest difficulty was experienced in adapting the edge of the mucous membrane of the stomach to the skin; the opening thus left was about large enough to admit the little finger. The operation was now completed without hæmorrhage (one vessel only being tied); and without great distress to the patient, immediately 2 oz. of warm milk, in which an egg had been beaten, were poured into the stomach.

It will be observed that chloroform was not administered, although this agent has lately been described as a beneficial stimulant. This can only apply where small quantities are taken, for where the full effects of the drug are required, that is, in the performance of an operation, I know of nothing more likely to produce unpleasant consequences, such as vomiting or great prostration, or even death in such a patient as the present. Vomiting, above all things, was to be avoided, and as regarded avoidance of pain, I did not consider that the necessary incisions would be of a very painful kind. Moreover, the patient was remarkably cool, collected, and fearless of pain. All these considerations induced us to dissuade him from taking chloroform.

The position of the stomach in its natural condition determined the line of the first incision, viz., at the linea semilunaris, extending from the edge of the cartilages downwards; and with a view of testing the facility or otherwise with which I could reach the organ at this spot, I performed the proposed operation on the dead subject at this place and also at the linea alba. I soon discovered that with the former incision the stomach was not found with so much facility as in the latter, covered as it was by intestines; whereas, upon operating at the linea alba, immediately below the xiphoid cartilage, by simply raising the liver the stomach was exposed. Notwithstanding this, however, the fact that in the latter incision the pyloric end of the stomach instead of the cardiac was most likely to be opened, which was not desirable, and also remembering that the natural position of the stomach was in the left hypochondrum, I determined on adhering to my original intention of making the first incision at the linea semilunaris; moreover, the intestines would be less likely to interfere with my finding the stomach.

Sedillot, of Strasbourg, who has twice opened the stomach, made his incisions in a different spot, but I had not at the time I performed this operation seen any account of his proceedings; and my object being to get as near as possible to the cardiac end of the stomach, induced me to adopt my present plan. I can see no object in making a crucial incision through the rectus muscle, as recommended by that surgeon.

It will be observed that I was especially cautious in avoid-

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ing any chance of the stomach becoming detached from the abdominal parietes, and I therefore sewed the organ to the parietes with an uninterrupted suture, taking also special care to include a good portion of the walls of the stomach in the stitches. I have since found that the accident which I mention did occur in one of Sedillot's cases, and that soon after the operation was completed a violent fit of coughing tore the ligatures away and discharged the contents of the stomach into the peritoneal cavity.

Plate I—IV

Illustrating Dr. Habershon's and Mr. Cooper Forster's case of Gastrotomy.

Plate

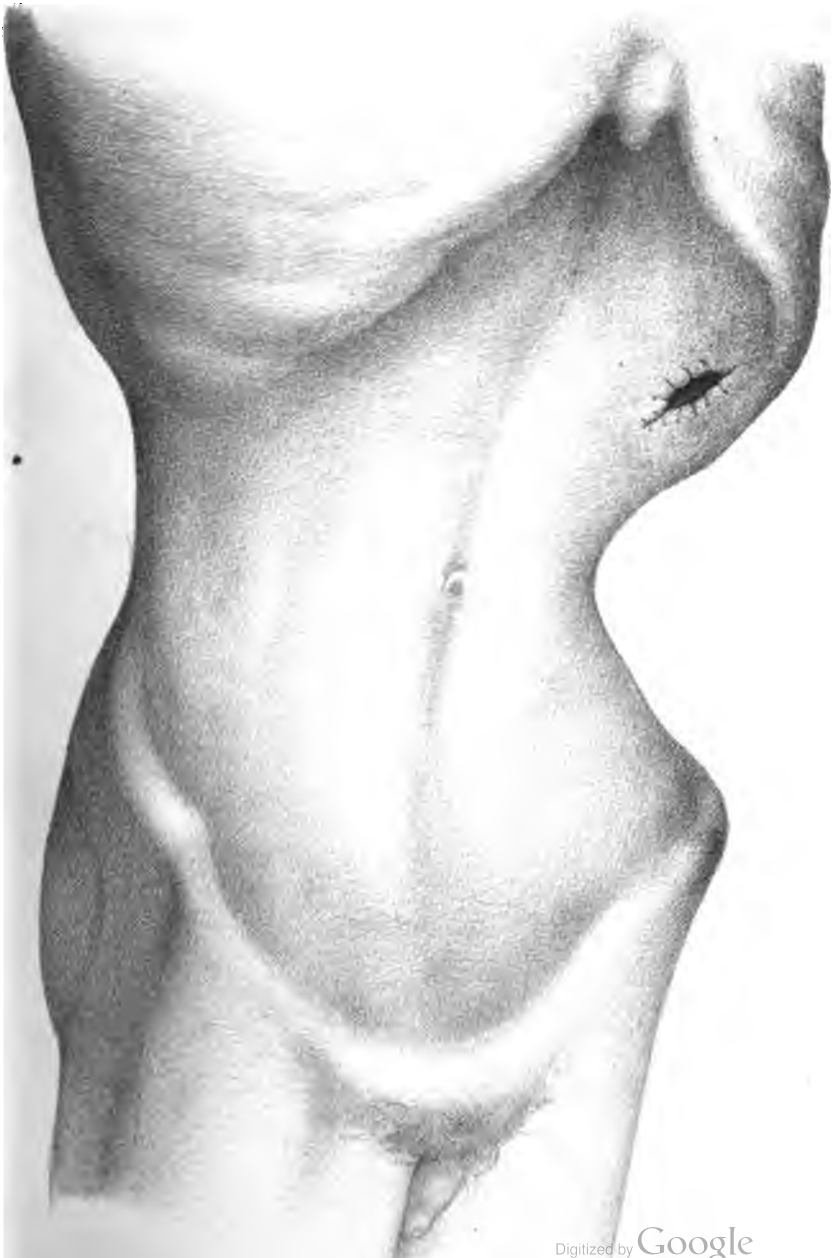
I. Shows the external incision in the left hypochondriac region.

II. Shows the position of the stomach drawn up to the opening, after the interior of the abdomen had been exposed.

III. Exhibits the interior of the stomach, with the opening seen from the inside.

IV. Shows the growth in the œsophagus causing its almost entire occlusion.

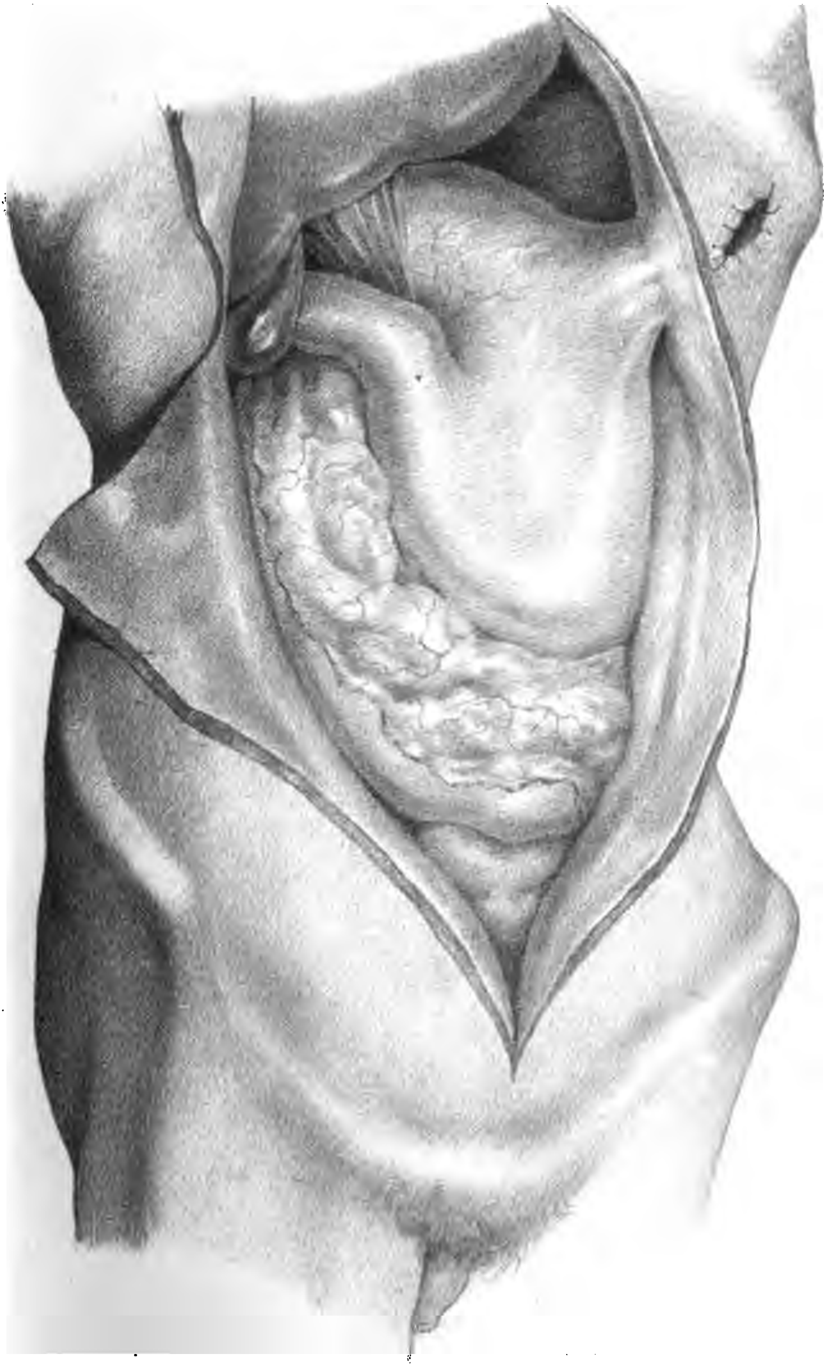
Plate 1



W. Hurst

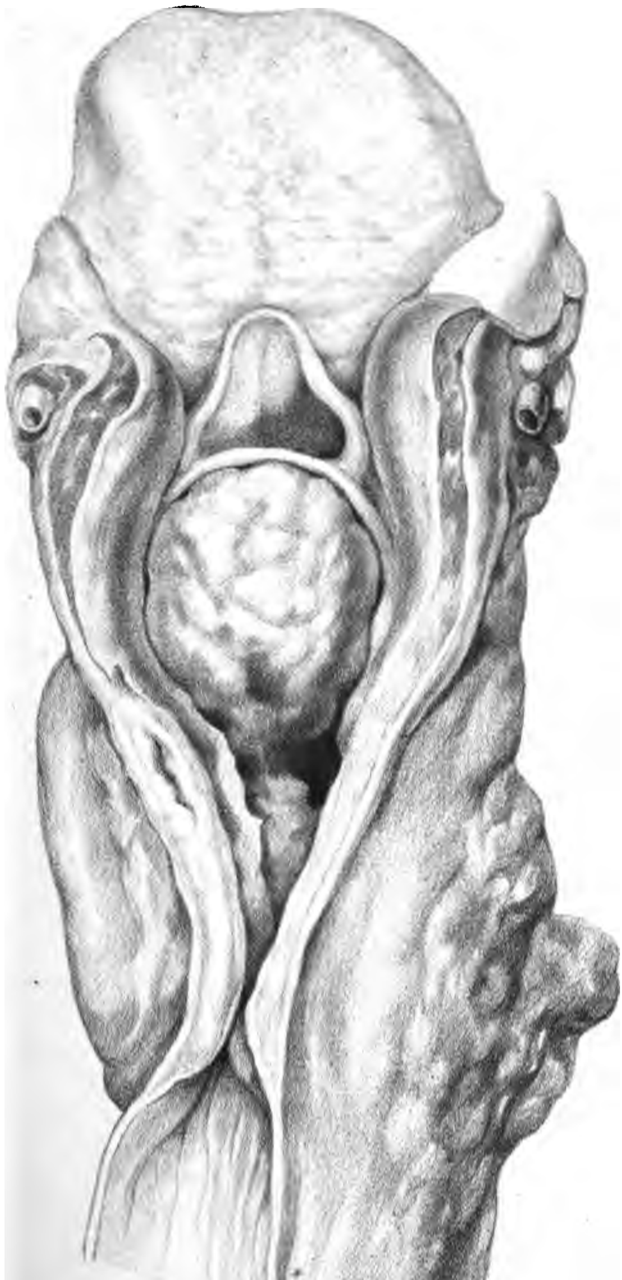
Day & Sc

Plate. II



Day & Son, Lithrs to

W. Hurst.



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PATHOLOGICAL OBSERVATIONS.

BY SAMUEL WILKS, M.D.

FROM a careful review of the reports of nearly 2000 post-mortem examinations, of which we have notes, we have been enabled to make several pathological observations on subjects of interest, and had prepared them for publication; space, however, will not allow us to allude to more than one or two of them; the others must be left to a future occasion.

ON CANCER AND NEW GROWTHS.

WE will state at the onset our firm conviction that cancer, in the commonly received acceptance of the term, has no peculiarities which can always distinguish it from other morbid growths, or even from many healthy structures. Some experience in testing this debateable question has satisfactorily proved the truth of the assertion, having seen, for example, well marked encephaloid disease, which displayed merely small nuclei by the microscope, offering nothing peculiar to the eye of those well versed in the use of the instrument, and, on the other hand, we have known healthy cells from parts of the alimentary canal, from the kidney, from the Pacchionian bodies, &c., considered as cancerous when this idea of their nature was suggested to the observer. Without denying that the microscopic elements of healthy structures have their peculiarities, or that morbid ones essentially differ from them, we believe that our statement is correct, that the peculiarities of cells arising from size alone have not hitherto been sufficient to enable observers satisfactorily to distinguish between them.

We think, therefore, that the terms *heterologous* and *analogous*, applied by Carswell to growths, according as they consist of structures foreign to the body or similar to it, are erroneous, although they may be usefully applied in a modified sense. They appear to have been adopted to give scientific expression to the generally received opinions concerning new growths or tumours, that these consist of two classes, cancerous and non-cancerous, or malignant and benignant, thus indicating that the former consist of elements *foreign* to the system, while the latter are composed of tissues *allied*, and therefore innocent. This idea has hitherto been underlying all our technical terms relating to the subject, and much clinical observation as well as microscopic research has been directed to the object of elucidating the important point respecting the malignancy or non-malignancy of an adventitious product, and we must admit that some very high authorities assert their capability of always making the distinction. They maintain that cancer consists of cells which are distinguishable by their form and size, and thus indicate a formation peculiar, and foreign to all other structures. Our own opinion, from long study of the subject and from observations during several years of a multitude of examples of tumours (arising not only from the examination of dead bodies, but from the opportunity of seeing specimens daily removed by our surgeons, as well as those sent to the museum) is, that these new formations exist in very large numbers, and are of very various kinds, and that if they be placed in a list according to the rapidity of growth, disposition to spread, propagation, &c., those at the top of the scale may be styled cancerous, but that no boundary line can be drawn between the last which is styled cancer and the next on the list which has acquired some other name, and also that if the term malignant be applied to those which are highest on the list, and semi-malignant to those below, and innocent to the lowest, that still no clearly defined lines can be made between these divisions. We believe, indeed, that the same rule holds good in morbid anatomy as in all creation, that the transition from one natural object to another is by insensible degrees. With this view of the subject, such defined terms as cancer and malignant afford a hinderance to its proper comprehension, and could they be removed, we think much light

would be thrown upon it. As, however, this cannot be done, they must be retained in a qualified sense, and the term cancer be employed to designate two or three of the most malignant forms of growth, the term malignant being itself a relative one, its meaning being a disposition for the adventitious product to return and propagate itself. The question, then, to be asked with reference to a new growth is not so much—is it malignant or not? as—what *degree* of malignancy has it? The answer must be discovered by clinical observation and microscopic investigation. For it is evident that if there be a number of new growths, and some of these consist of fibre, others of bone, &c., that only a small part of the subject is considered by regarding cancer alone, for we wish also to know, as in the case of osteoid disease, what is the peculiarity of the bone which constitutes its malignity.

Let us inquire, in the first place, what determines the presence of an adventitious growth or deposit in the body. Two causes are in operation in different cases—a local and constitutional, and upon the separate action of these do we have the extreme forms of benignant and malignant growth, and upon their combination do we have the great number of their intermediate varieties. The first cause alone in operation has a tendency to the formation of a tissue allied to the healthy structures, whilst the latter has simply a power for the production of the simplest elements, as seen in malignant growths. The latter, however, may have secondary characters given them by local causes, and thus an explanation of the various intermediate forms of morbid productions. To discover how much one cause is in operation and how much the other, we think is the clue to the whole question of new growths, and now we may see a meaning in the terms heterologous and analogous, as applied to new formations, for if the latter be allied to the structures near which they spring, they indicate a healthy influence in operation, and therefore an absence of any vicious constitutional tendency; whereas if they be not allied, that is, consist of cells continually growing for a purposeless object, they indicate a vice in the system; the latter are foreign to a healthy intent, and therefore deserve the name heterologous. In the one case the tendency is to a formative process, and the nearer this approaches to the natural one, the more benignant the

structure, while in the other case the tendency is to the production of cells such as existed in the embryo preceding the formation of the tissue, and therefore if such embryonic cells spring up and continue to grow in the perfected body, we have a cancer; a cancerous tumour being simply a mass of embryonic cells. Our meaning is this, that in the healthy organism the blood maintains in integrity the different structures of the body; every part, however complex, we believe is constantly being renewed; this is due to some close affinity between the textures and the blood-ingredients. Let, however, there be some injury by which a breach of surface is produced, a plasma or blastema is thrown out to heal it, but the affinity is in great measure lost, for though the disposition still remains for a reproduction of the parts, the latter is only practicable within certain limits, in the production of the simplest structures, for as regards the viscera, these we know are never reproduced, and the same may be said of muscle and probably of nerve, unless in young subjects. The blastema, then, can only form tissues of the simplest kind, and thus the repair is generally by fibre, or, if near bone, by osseous tissue or cartilage. If the local injury should cause an effusion of blastema not required for the repair of a part, we have a simple tumour springing up, fibrous, bony, &c. Now, suppose there be a vice in the constitution, the disposition in the new formation to ally itself to the healthy tissue shall be still less, and a tumour, which would otherwise have been an innocent fibrous one, shall be further removed from this degree of development, and a mass of cells shall spring up having no tendency whatever to the formation of a tissue, and thus constituting a cancer. In this latter case there is probably a local cause for its production in one part rather than another, though this we know is not allowed by some. Our own opinion is that it is an injured or the weakest part of the body which is the seat of the disease, in an analogous though opposite way in which tubercle appears to attack the most active organs. We think this is seen in numerous instances, such as scars, ulcers, moles, &c., becoming cancerous, cancer of gall bladder succeeding to gall stones, cancer of kidney to calculus, and the same in urinary bladder, several examples of which we have seen; and as regards injuries, the constant repetition of such a history in all forms of tumours cannot be disregarded

and they afford an explanation of our view of the subject. A part is injured in a healthy person—repair takes place, or a material is thrown out from the blood-vessels, which to a certain extent developes itself; whereas, if there be a constitutional vice, as a cancerous diathesis, the blastema produces a number of cells having no object, and a cancer is formed. In answer to the objection that these cancerous growths pervade all parts, and thus show a general cause in operation, we maintain that they always have a local origin in one particular part, and that the disease is generally local for a considerable period; and in answer to the difficulty why the weakest part should produce a rapid cell-growth, we can only state that this is so; that in the healthy body the disposition is to develop a new material allied to the old and highly-developed tissues, and in the vicious system it is the reverse, and, moreover, it must be remembered that the cachetic condition spoken of in cancer is a result of the disease, and does not pre-exist, and in very many cases is not present at all, and depends, as we have before remarked, upon accidental circumstances; moreover, the most rapidly growing cancers are often in the young. We may here state that the highly malignant growths, having characters allied to those of the parts near which they spring, shows that the local influence imparts a secondary character to them, though it does not remove their nature. Before considering this matter further, we will briefly review the commonest forms of growths, and we shall thus, by illustration, be better able to elucidate our subject.

Scirrhous cancer, medullary cancer, colloid cancer, melanosis, villous cancer, fibrous tumours, recurrent and malignant fibroid tumours, fibro-nucleated and fibro-cellular tumours, enchondroma, exostosis, osteosarcoma, osteoid cancer, myeloid tumours, uterine and prostatic tumours, glandular tumours, adenocele, tubercle, lardaceous material, fat, fibroid and inflammatory deposits, &c.

We shall not enter into the minute anatomy of these growths, as the account of their structure may be found in the various works on pathology, but merely allude to them to show their points of affinity. We will again repeat, that the blastema thrown out under abnormal circumstances has a tendency to assimilate itself to the structure near

which it occurs, provided the latter be of a simple character; and this tendency is greater the more a local cause alone is in operation for its production. Under ordinary circumstances the tissue would be simply renewed, and here a new growth occurs which has a *disposition* only to be like those from which it springs. In the majority of cases, therefore, new growths consist of little else than cell or fibre. Now, let there be an hereditary disposition to cancer, or some inherent vice in the system, instead of the healthy nutrition continuing, the blastema shall simply form cells such as existed in the embryo; these are rapidly reproduced, without any disposition on their part to form a tissue analogous to that from which they spring, and such a mass formed of embryonic cells constitutes *cancer*. Any disposition these cells have to form fibre, the next simplest element is a remove from their simple character, and indicates a less malignant diathesis in operation. As nuclei, however, probably exist before cells, if we have a rapid production of nuclei, an *encephaloid or medullary cancer* is formed; for if a cell-wall be formed around the nucleus, and should some fibre tissue also be produced, we have a *scirrhous cancer*, of less rapid growth and malignancy. Again, should the whole of the cells be changed into fibres, the disposition to rapid production is less virulent, a longer time is required in the formation, and there is a disposition to approximate to healthy tissue; we thus have *malignant and recurrent fibroid tumours*, tumours which recur and recur during a lengthened period, and only at last becomes propagated in the internal organs. The original cause of the growth in this case is often more local than constitutional, for the system may remain free for many years, while the growth is being constantly renewed in its own seat. Other forms, as *fibro-nucleated* and *fibro-cellular*, may return after removal, while some fibrous tumours are quite local and innocent in their character, the original blastema becoming at once a mass of simple fibre or connective tissue. The microscope is of essential value in distinguishing these tumours and expressing their various rates of growth and degrees of malignancy; and it is remarkable, that it was this very class of growth which formerly obtained for the instrument much discredit; for the doubtful answers given by it were supposed to signify its in-

capability of analysis, whereas they really indicated the truth, since intermediate or semi-malignant growths were under consideration. It would seem then, as a rule, that the rapid production of nuclei or nucleated cells indicates a vicious or cancerous diathesis, while the disposition to form fibre shows a disposition less vicious, though there certainly are cases where a malignant structure is composed of neither one nor other material; but whether this strengthens the rule or is opposed to it, we cannot at present say. Of such we shall presently give an example. As regards fibrous cancer or scirrhous cancer, we have not entered into any details respecting the nature of the matrix, but simply state our belief, that the firmer the growth the less malignant, remembering always that this matrix may or may not be a new formation, but a part of the healthy tissue; for example, a scirrhous breast is removed, and in its place a medullary tumour springs up, that is, the cell-growth took place primarily in the fibrous network of the mamma, and, in its reproduction, it had simply a new formed tender matrix of its own. A mass of cells or nuclei, with a simple form of matrix and blood-vessels, constitutes medullary cancer; and if there be a fibrous matrix with cells between, a fibrous cancer; and if all the structures be fibrous, that is, consisting of nucleated fibres, we have a recurrent fibroid tumour. We can, therefore, see how a fibrous cancer and recurrent fibroid may, under some circumstances, pass into one another, although they are generally distinguishable. We have left out of the question the formation of blood-vessels, for at present we do not see whether their production has more relation to malignant than innocent tumours, being found highly developed in many forms of both.

We may here again allude to the objection to this view of new growths, that if cancer be something not foreign to the system, why should its seeds be taken up and find fresh soil in other parts of the body? It might be said that there is a vice in the constitution, and therefore the removal does not affect the propagation; but this we shall find to be only partly true, for it leaves unexplained the reason why the secondary growths should resemble the first, when those primary ones have certain characters dependent on a local cause; and we might here allude to the analogous case of

pyæmia, where a local cause is sufficient to propagate disease through the body. Upon this point hinges the principal weight of our argument, our belief being that the degree of malignancy, as indicated by a cell- or fibre-growth, depends mainly on a constitutional disposition, but other characters are adventitious, or added, or dependent on a local cause. Now, if these latter characters are accidental and yet reproduced, it would show that if a tumour is reproduced after the removal of the primary one, that the seeds were already sown before the operation, or were left behind at the time. To this statement we can see no objection, and if true, is highly important, for if the accidental characters be propagated thus, it may be that the more essential ones are under a similar influence. It is thus seen that although there are great difficulties in the way of the microscope determining the degree of malignancy in any tumour, yet clinical observation cannot always be relied on as the only test, at least if based only on the fact of return or non-return of a growth after removal.

Our meaning will be more clear when we have advanced a step further, and taken some other examples. We say the disposition of new growths is towards the production of cell or fibre, and other characters are added, such as those due to bone, cartilage, pigment, gland-tissue, &c. The latter can only be developed in the immediate neighbourhood of its own tissue, but the three former may be reproduced in several parts of the body. Suppose, for instance, the same cause which gives rise to a cancer on the surface should affect a bone, we may have here also a medullary or fibrous cancer rapidly destroying the structures near which it springs; but very often the growth is modified by the neighbouring structures; the cell-formation in bone shall, in fact, become bony, and we have *osteoid cancer;* this is propagated through the system in the same way as cancer, differing only from it in the deposit being osseous. Should the tumour be of slower growth, such as would be fibrous in the soft parts, it is here disposed to become bony, and we have *osteosarcoma,* which may, perhaps, be innocent, although, in most cases, it has a near relation to the recurrent fibroid, and has the same degree of malignancy and is propagated through the body as osteosarcoma, or an osteo-fibrous tissue. In this case we should remark,

that the secondary deposits in the lungs and elsewhere consist of true bone. Since the blastema poured out in the neighbourhood of bone is disposed to form cartilage, so here the tumour may contain cartilage, and thus more or less of this substance is found in this class of growth. We think, then, that a tumour which may be simply fibrous or cancerous on the surface of the body, may, near the bone, be changed partly into bone and cartilage, and the disease be thus an osteoid cancer or osteosarcoma, the degree of malignancy depending on the disposition to form a cell-growth, the bone or cartilage being merely secondary, notwithstanding that these secondary characters are equally propagated. Just as the fibrous tumours vary in malignancy and rate of growth, so do the osteosarcomatous, and thus we may have a simple fibrous tumour growing around the shaft of a bone, or a fibrous tumour, with various amounts of osseous or enchondromatous tissue, with the former material in increasing quantities, until a simple bony tumour is produced. Again, if the cause which calls into action a new growth should be in operation in the centre of a bone, we may witness the production of some of those elementary cells of the medulla which were found in the fœtal state preceding the formation of the bone; these are large branching cells, many nucleated, and are called myeloid. These embryonic cells, being reproduced in the adult, grow continually until a tumour is formed, bearing the same name. This growth of embryonic cells might appear to relate it to cancer, and constitute it eminently malignant, but the analogy is not perfect, as facts show. The cells which are capable of growing in *any* part are of a simple kind, and are such as may spring up anywhere, but the myeloid are only produced under the influence of the medulla in the same way as an osseous tumour is produced under the influence of bone; but since the latter may accompany a malignant growth, so may the former, and thus it has not yet been shown that a myeloid tumour can arise primarily in any other organ than a bone, nor in its simplicity be propagated. A myeloid material may, however, accompany any form of growth from bone, and be propagated with it; such, however, cannot be styled a myeloid tumour. And here we may remark, that the designation of a growth cannot be taken from one element only which it

contains, for that may be secondary and the non-essential part. Thus, a tumour composed of bone, cartilage, fibre, simple nucleated cells, and myeloid matter, is no more deserving the name myeloid than osteoid; one element, no doubt, is more important, as indicative of malignancy, than another, but until a knowledge is obtained of the degrees of malignancy of the various tissues, it is an assumption to give a designation founded on the presence of one particular element, which may, in fact, be a non-essential part of the growth.

We ought to allude to the fact of those exceptional cases where bone and cartilage spring up independent of the neighbouring influence of the osseous skeleton. Such class of tumours, however, are exceptional, and have their favorite seats; moreover, they do not afford the well-marked characters of the same structures when growing near the bone. Thus, in the neck, near the angle of the jaw, we have the fibro-cartilagenous tumours, but a microscopic examination of a tumour from this region shows it soft in structure, although, from the character of the fibre and cell, we see how near is the approach to osseous structure, and how, therefore, a small quantity of bone may occasionally be produced. The other most remarkable seat for their production is the testis, where bone and cartilage are occasionally found.

With regard to *melanosis*, although this is a form of disease dependent on the propagation of an ill-formed cell of a dark colour, it very often is nothing more than one of the forms of tumour of which we have spoken combined with pigmentary matter; that is, a cancerous (cell) growth, or a recurrent fibroid growth associated with pigment. We would not say that melanosis may not be a disease *sui generis*, but it is a remarkable fact that in very many instances the presence of the colouring matter seems determined merely by a local cause; thus the frequency of melanosis of the eye, on account of contact with the choroid coat, and the constant occurrence of melanosis having its source in a mole. Several such we have witnessed, and will presently mention an example. The fact is highly interesting, as showing a distinction between the essential character of a new growth and its secondary or accidental ones. The long-noticed fact of the frequency of melanosis in gray horses bears upon this point. We think

the pigment in many cases may originate merely as altered blood, and so be propagated; in many instances the pigment in a solitary tumour is nothing more than hæmatin; in chronic peritonitis the black spots so often seen, appear to have originated in this manner. In illustration of the remarks which we have made, several cases will be found in the last volume of this work, and we will now mention briefly one or two others. Simple fibrous tumours need no examples.

Recurrent fibroid.—A woman, æt. 43, had suffered for six years from a tumour on the leg; this was removed, and returned four times subsequently after excision, until death occurred from exhaustion; the body being healthy.

The same form of tumour, having a degree more of malignancy, in the case of a woman who had a tumour frequently removed from the gluteal region, and at last she died from the occurrence of similar growths in the lungs.

This class of tumours has hitherto been considered on the external parts of the body and with reference to surgery, but they may spring up primarily in the internal organs, as in the following case.

Recurrent fibroid tumour of the lung.—James L., æt. 46, had suffered for some weeks with dyspnœa, &c., due to a gradual consolidation of the left lung, and after death the chest was found filled with a large fibrous growth, which corresponded exactly in structure to the ordinary recurrent fibroid growths. None in any other part of the body.

Such growths in the uterus we believe are not uncommon, having now seen several.

Elizabeth F—, æt. 56, had for many months suffered from uterine hæmorrhage, and portions of the growth from which this proceeded were several times removed. After death a large part of the inner surface of the uterus was found covered with a growth which was sloughing, but which consisted of nucleated fibre, and corresponded exactly to this form of tumour which we are considering. There was no disease elsewhere.

The intermediate character of the tumour, as regards its malignancy, between cancer and polypus, is shown by the manner and seat of growth, being not so destructive as the former nor so limited in its seat as the latter, but involving nearly the whole inner surface of the womb. In a very similar case of many years' standing, the woman at last died with a number of tumours of the same character in the lungs.

We have stated our belief that if this class of tumours should arise near bone, they would assume in part an ossific or cartilaginous character. The more innocent or simple tumours of the surface would be represented by enchondromata or exostoses, while a recurrent or malignant fibroid would be represented by osteosarcoma. Just as the former has degrees of malignancy, so also has the osteosarcoma, and so do the proportions of fibre, bone, and cartilage, vary in amount. A malignant fibroid would represent a malignant osteosarcoma, as in the following case.

A woman, æt. 27, suffered for four years from osteosarcoma of fore-arm; the limb was amputated, and she died six months afterwards, when osteosarcomatous tumours were found pervading the lungs, these consisting of fibrous tumours surrounded by true bone, the softer part exactly corresponding to the structure of malignant fibroid.

Ordinary cancer is too well known to need any examples. When attacking bone, some bony matter may sometimes be developed within it, and occasionally nearly the whole of the deposit may become osseous, when it constitutes osteoid cancer, and is developed in the form of bony tumours throughout the lung. We will refer to the last volume for an account of myeloid tumours, which in their simple character appear to be innocent; but a cancerous tumour may have not only bone developed in it, but also myeloid matter, of which the following is an example.

George W—, æt. 18, had his leg amputated for a large tumour growing from the bone, of a carcinomatous appearance. It was composed of a soft matter mixed with bone. The former consisted of large nucleated cells, cancer, and myeloid cells, and thus appeared to be an encephaloid growth, contain-

ing osseous and myeloid material. Within a few months the lad became paraplegic, and similar growths, containing all the above-named elements, were found in the spine and in the lungs.

In speaking of fibrous tumours, fibrous cancer, &c., we have not entered into the exact structure of the various elements, as this was not our purpose; but in speaking of fibre we mean nucleated fibre, especially in the malignant fibroid, the simple areolar or connective tissue being of a more simple character, although the two are constantly combined. We believe a tumour composed only of this simple connective tissue is quite local in its character and its operation, and is not propagated, and we think the same is true when it occurs internally, as, for example, in scirrhous pylorus. This term has long been used in the loosest sense, and has been regarded as meaning malignant or cancerous disease. This, however, cannot be substantiated by any reason. In cancer of the stomach the growth is composed of cells, and the neighbouring glands, or organs, are often affected, but in simple scirrhous pylorus the affection is altogether local, and no trace of disease is found in any other part, and the elements which compose it are as simple as in a chronic ulcer. We will briefly mention the two last cases we have witnessed.

Mary W—, æt. 22, had suffered for more than three years with symptoms of obstructed pylorus, and after death the body presented appearances of this disease in its most extreme form. The organ was dilated so as to fill the abdomen, and the pylorus formed a hard tumour. This on section was found to be due to a deposit of an extremely tough, simple fibre tissue beneath the mucous membrane. This had caused the obstruction and the fatal issue. It contained no juice and no cells, only a few nuclei brought out by acetic acid, and there was no disease in any other part of the body. Such a disease cannot by any method of reasoning bear the name of cancer or malignant. It contained no nucleated cells and had existed between three and four years without evincing any powers of propagation.

James P—, æt. 55, suffered for two years from symptoms

of well-marked scirrhous pylorus. As in the above case, the organ was much distended, and the pylorus formed a tumour composed of hypertrophied muscle and tough fibrous structure in the submucous layer. No disease existing elsewhere.

Cases of well-marked cancer of the coats of the stomach, especially at the cardiac end, associated with cancer in other organs, are too well known to need any illustration. As a good example of an intermediate disease we give the following, which cannot be regarded as ordinary cancer nor as a simple innocent growth. Such a case shows that there are forms of disease which will not answer to the old division of innocent and cancerous.

Elizabeth S—, æt. 18, had suffered seven months with sickness and other symptoms of gastric disturbance; a tumour could be felt in the upper part of the abdomen, as well as others in the lower part. After death the stomach was found affected in a very dissimilar way to that seen in scirrhous pylorus or cancer, the disease being intermediate in manner of growth as well as in character, being not so hard as the one or soft as the other, not so limited to the submucous structure as the one and not growing in a circumscribed mass as the other; moreover not consisting either of simple connective tissue or cells, but of nucleated fibre; the pyloric half of the organ was infiltrated throughout its walls by an adventitious structure, commencing in the submucous tissue, but pervading the other coats in many spots, and thus causing projections on the external surface. The walls were much thickened, and on section no juice could be expressed, although the structure was not very tough. Both ovaries were converted into large solid tumours, and consisted of tissue like that in stomach, of simple nucleated fibre, and closely resembling that seen in recurrent fibroid tumours. The case thus presented in every feature, anatomical and pathological, a disease intermediate between cancer and simple fibrous growth as seen in scirrhous pylorus.

The mention of ovaries and this fibrous disease causes us to allude to their connexion, as illustrating an intermediate form of growth between innocency and malignancy. Thus we have a cancer of the ovary on the one hand, and a simple cystic

disease on the other. In the latter we may have solid growths of a fibrous or cell character, constituting a cysto-sarcoma or cysto-carcinoma. If these solid parts predominate, we have a fibrous tumour, as in the above, or a cancer. The same varieties occur in the testes.

We are quite aware that the varieties of tumour are not exhausted by speaking simply of fibrous or cell-growths, although these indicate some of the main forms of tumours, but that there occasionally occur cases in which it would be difficult to place the disease under any of the above headings. Of such a case is the following:

Francis W., æt. 50. Ill five months with ascites and small tumours in both breasts. The post-mortem examination showed the mammæ containing small hard tumours, composed of fibre-tissue, with small nuclei. The peritoneum was covered with small hard tubercles, and the liver was occupied by a number of very hard nodules, as hard almost as cartilage, and semi-translucent. A microscopic section showed these to be composed of an homogeneous substance, containing no cell-structure, but consisting of a horny material, arranged in a reticulated or honeycomb form. Some neighbouring glands were infiltrated and indurated by a fibrous deposit, and the pylorus also appeared slightly thickened. The disease was probably allied to that form known as reticulated or hyaline cancer; its general distribution marked its malignant nature, although the absence of all cell-structure could not in any individual specimen have suggested the idea of cancer. Such a form of disease more clearly shows that other instances have to be studied, and the question is much larger than that embraced in a simple consideration of cancer.

We stated, with regard to *melanosis*, our belief, that in most cases the colouring matter was adventitious, and might be a secondary deposit in various forms of growth, and thus the different opinions as to the malignancy of this disease. A simple fibrous tumour for example, near the eye, may contain pigment, be removed, and not return. A cancer, however, in the same spot, may also be black, and that shall return. A woman lately seen had a cancer spring up on a mole on the

arm; it contained pigment, and was called melanosis. This was removed, and soon afterwards others occurred on the arm and body, and these also were melanotic. There seemed little doubt that the presence of the mole determined the presence of the pigment, the case being one of cancer, with this additional element accidentally added, but yet (which is the most interesting fact) propagated. A melanotic tumour may be also a recurrent fibroid, with the addition of pigment. W. W., æt. 53, had a tumour growing from a mole on the back for six years. This was removed, and was quite black from pigmentary matter. It again grew, and was removed two years afterwards, and in another two years had again sprung up, and was excised; and so a fourth time, when it was sent us, by Mr. Dolman, of Derby, for an opinion, without any history; and in illustration of the value of the microscope, we stated, from the presence of fibres with large nuclei and branching cells, that it was recurrent fibroid; and from the presence of pigment, had probably grown on a mole; which was exactly the case.

We have stated our belief that new growths are essentially of a very simple character, composed for the most part of cell and fibre, but that they may be modified in a few limited instances, so as to resemble the texture near which they grow, provided that be not very complex. Thus, we think, cartilage, bone, and colouring matter are added to growths, in consequence of the latter springing up in the presence of these substances, and so other forms of tumours under similar circumstances. In the uterus, the fibrous tumours which spring from its walls are composed of the same tissues as the organ itself, and thus the microscope displays in them those muscular bands which are ingredients of the healthy structures. As might be supposed, these are best seen when the tumour is developed during the evolution of the uterus in pregnancy. The same holds good in the prostate of the male, in the smooth, rounded tumours so often seen in this organ, as well as in the so-called third lobe, both of which are found to possess the same character as the original tissue. Gland-structure of a simple follicular character may also be reproduced, and thus tumours about the lips and gums may be found to contain it. With these exceptions glandular tumours are not known elsewhere

than in the female breast; and thus the term *adenocele* has been applied *par excellence* to the chronic mammary tumour. These growths, however, are of a very simple character, and only in part resemble the original tissue, the gland-structure consisting seldom of anything more than cæcal terminations of ducts. By bearing in mind what has already been said of the essential characters of new growths, their simple fibrous and cellular character, on which depends their degree of malignancy, other characters being adventitious or dependent on a peculiar local influence, we shall be able to see how these tumours of the breast vary in malignancy, and to explain, we think satisfactorily, why some of the so-called adenoceles have been known to recur. As long as the idea was prevalent of an innocent growth being one thing, and malignant another, or heterologous, the pathologist had to decide on this assumed ground of distinction, to which class of tumour any specimen belonged, and, although he might be able to do so in a certain number of cases, he met with others which presented doubtful characters; but being obliged to place them in the one category or the other, great error was often committed, and serious mistakes in prognosis given. By considering, however, that we have to do with a scale of new growths, the difficulty ceases. Let us look, in the first place, at the two extreme cases. A woman of middle age receives a blow on the breast, a slow growth springs up, composed of nucleated cells—this is cancer. Let the same local cause be in operation in a young woman of comparatively healthy constitution, when the procreative powers are in full force, and then the blastema or crude formative material supplied by the blood is disposed to assimilate itself to the natural structure, and the growth resembles, though imperfectly, the original gland; we thus have a mammary tumour or adenocele. Such a growth, dependent for its character on the proximity of the gland, cannot be propagated, and it is therefore innocent, and may thus be compared to an exostosis growing from a bone. We may have, however, an intermediate form of tumour; the one formed neither of a rapid growth of cells, nor one formed of gland-tissue, but of nucleated fibre, such as is seen springing up in other parts; and thus a recurrent fibroid tumour may occur in the mammary gland, as well as elsewhere. This intermediate form of

growth shows an intermediate condition of morbid influence, not a constitutional vice, as in the first instance, and at the same time a want of that healthy action necessary to produce an adenocele, or an analogous tissue, as seen in the second. There was lately in the hospital a woman in whom such a tumour had been removed for the third time from the breast, and has now sprung up for a fourth time. Now, let us consider another case in which the blastema shall form partly into fibres, and partly into gland-tissue, and this combination no doubt exists in different degrees in a large number of adenoceles; but let the former, the recurrent fibroid element prevail, and we have the condition present for a return of the disease. This is an explanation of those cases of tumours where gland-tissue has been found, and the name adenocele accordingly given; and yet the disease has returned. An interesting example of this we have lately witnessed in the hospital, in the case of a young woman who had a tumour removed from her breast for a supposed adenocele of several months' growth. Its general appearance was not that of cancer, and imperfectly formed gland-tissue was found within it. After a few months the disease returned, when no cæcal terminations of ducts could be found, but merely nucleated fibres. It was removed, and immediately afterwards a third sprung up in the cicatrix, and shortly disease manifested itself in the chest, which, from the physical signs, left no doubt as to its being a growth in the lung, although no post-mortem inspection took place. The first tumour consisted of a combination of an adenocele and recurrent fibroid, and because the former was present, it was hoped that the disease was simply an adenocele; whereas the latter was really the pernicious element, and that which afterwards propagated itself alone; and here again we may allude, as we did in reference to tumours of bone, to the error of designating a tumour from one of its constituents alone. It may be a question, whether a cancer and adenocele may occur together, whether some gland-tissue might not occur in a tumour where there was also a simple cell-mass constituting cancer; we have never seen such, and it would seem improbable that the opposite conditions necessary to produce the two should occur at the same time; but, inasmuch as in the

case just mentioned, a growth which commenced as an innocent one or adenocele, may subsequently rapidly grow as fibre, we might, therefore, imagine even a greater degree of malignancy to attack it, and a cancer be produced. We do not see the impossibility, however, of such a form of tumour which our old notion of innocent and malignant could not have allowed; indeed, we quite think it proved, not that an innocent tumour may become malignant, but that a tumour, for example, commencing as a fibrous, may end as a cellular or cancerous.

Many other new formations, yet to be alluded to, have their peculiarities in a local cause; thus *epithelioma* has its character determined by the surface on which it occurs. The cell-growth shows the malignancy, while the character of the elements, and their resemblance to the natural structure, shows the modified malignancy. The cell is not one containing a very large nucleus, as in ordinary cancer, which could propagate itself through any part of the body, nor is the cell a healthy one; but it is modified, it resembles the epithelial cell, but contains a larger nucleus. As a local cause is necessary for its formation, so it has little powers of propagation, and we have never yet seen a case where other parts than the original seat were involved, unless by contact. In one case of cancer of the œsophagus, involving a very large surface, there was a slight growth in lung and liver; and in these organs there were none of those peculiar capsular bodies, but only abortive epithelium. This constituted the exception which proved the rule—the inability of true epithelial growths to propagate themselves. We are quite aware that epithelial growths have been described as springing up on other surfaces; but we believe these have been confined to the cranium and its membranes; and it is a remarkable circumstance, that sometimes there is met with on the surface of the brain cholesteatomatous tumours which in their elements exactly correspond to those found in the sebaceous tumours of the skin. It has not yet been quite made out in what structures of the cerebral membranes these have their origin.

The so-called *villous cancer* has been much discussed as to its malignant or innocent character, but, according to our own views, the villous character of a growth arises merely from a

local cause, and may attach itself to various forms of tumour; from clinical experience as well as from microscopic examination we feel assured that this is the fact. We believe the villous character is local, and may be added to any basis. Thus, in the bladder, there is that remarkable form of disease consisting of small vascular villous tufts, of very small size, and which often produce death by hæmorrhage; and at the same time a very similar villous growth may have for its basis a cancerous tumour in the walls of the bladder; this may be seen in various specimens in our museum. In one decided cancerous specimen the chorion-like villous processes are remarkably well shown. The same is true of the stomach and intestine. In the latter some of the local structures with a villous surface have not been cancerous, but on the other hand many cancerous tumours are villous on their free surface. An excellent opportunity for determining this point lately occurred in the case of a man who had large cancerous growths in the duodenum and other parts of the intestinal canal. Between these there were numerous small shaggy tufts, which under the microscope showed a beautiful villous structure, yet these, had they been met with separately or alone, would undoubtedly have been called non-cancerous, as no deposit beneath them was observable, although probably there was a morbid or carcinomatous substratum.

An interesting case came under our notice a few years ago in Dispensary practice bearing upon the intermediate character of this disease. A man who had long suffered from dysenteric symptoms and ulceration of the intestine, during his convalescence was taken with constipation. This continued many weeks, at last became insuperable, and he died. A post-mortem examination displayed an extensively ulcerated large intestine, with the ulcers undergoing cure; one of these, at the middle of the colon, had contracted so as to cause obstruction; the coats of the intestine at this part were exceedingly thickened, the submucous tissue as well as mucous, and from the free surface there hung a shaggy growth. The disease corresponded in every respect with what we have seen called formerly a scirrhous contraction, and more lately a villous cancer. There was no other disease in the body.

We believe the same is true of *warty growths* of the skin and *papilloma*. These are sometimes of an innocent nature and sometimes malignant, that is, allied to epithelial cancer. An innocent growth may become papillary and so may a malignant one. We may, as a rule, distinguish between the extreme forms of both, although we think they are often confounded, and that frequently a penis has been amputated for an innocent warty growth in the same way as a warty growth from a sebaceous cyst has been considered malignant. It is difficult to draw a line between simple and malignant, particularly in those cases of chronic ulcer of the leg, which, after existing many years, are called cancerous; we believe here that a chronic change has existed for several years in the cutaneous structures which at last puts on that form in which good tough tissue is replaced by a rapid and morbid production of cells, which in its turn constitutes a disease rather than an effect, and may pervade the bone and deeper-seated parts. A simple chronic ulcer, in fact, becomes malignant by this alteration in the character of the product, arising from an alteration in the constitution of the patient as he advances in life.

It has been stated that the villous character of some intestinal growths has been due to their partaking of the character of the mucous membrane, but an objection might be raised against this, seeing that similar growths occur in the urinary bladder. It should be remembered, however, that probably some purely physical influences were in operation in determining the character of the villi of the mucous membrane and the columnar epithelium[1] during their first development; and that morbid growths are under a similar influence; and that the urinary bladder is under similar conditions as the intestine in extra-uterine life, although it was not so at the time of development; that is, a free mucous surface opening into a free space. By taking the analogy of effused lymph on a serous surface, we see

[1] Our philosophic friend, Mr. Hinton, has for some time been studying this interesting subject in reference to development, *i. e.*, the necessary effects produced on the growing structures according to the predominating influences of the internal forces and the external or mechanical pressure, and we believe his views are embodied and are expected to be published in the present number of the 'Medico-Chirurgical Review.' We have long explained the various forms of morbid products as tubercle on these simple mechanical grounds.

how simple mechanical conditions modify its appearance, the flattened layers of lymph in pericarditis, when the surfaces approximate, and the villous shaggy condition when there is much effusion. Thus the disposition for growth, from basement membrane of bladder or intestinal canal, is to become villous. We have, in the Museum of Comparative Anatomy, some specimens of hearts of the ox, which are said to be the subject of fungoid disease; the whole pericardium is covered with long, shaggy tufts, somewhat like the lymph in pericarditis, but at the same time these shreds are firm, smooth, and have evidently been long attached to the serous surface. Whether it is more just to call this a villous growth or the result of a pericarditis, from which the animals have recovered, is difficult to determine.

Whatever views may be taken as to the nature of a new growth, there can be little doubt that the most important fact which can be known about it is its proneness to return or to propagate itself—in fact, its malignancy. As, however, such qualities for rapid propagation differ in degree, the term malignant is necessarily a comparative one, and cannot be applied to any particular form of tumour or cancer, unless the latter be used in as loose a sense as the word malignant. The various characters of innocency and malignancy are to be discovered by clinical experience and microscopic observation. In the preceding pages we have pointed out our belief that many of the varieties or peculiarities of growths or tumours depend altogether upon local causes, and that these are by no means essential to the tumour as indicative of a constitutional vice. That a similar local cause will produce a different effect in different individuals is sufficient to show that there are different constitutions or dispositions to disease; and we believe the constitutional malignancy shows itself in the disposition to produce a cell or fibre-growth, while other characters arise from a local influence, the reason for this latter opinion being that similar growths, having these secondary characters only, arise altogether from a local cause, and are of an innocent nature. These innocent or secondary characters are such as have been referred to under cartilage, bone, colouring matter, villous and warty structures, &c. If this should not be the fact, but every form of morbid growth be peculiar, and constitute a distinct form of disease, as is sometimes thought, why should not, for example,

osteoid cancer have its origin in some other part than a bone? Why should it not commence sometimes in the lung, where it is met with as a secondary deposit? We think this is sufficient to show that the presence of the osseous skeleton whence it springs determines its osseous nature, and this is corroborated by the fact that the secondary growths in the lungs in these cases are less firm than the original tumour, from containing less bone. If this be true, the secondary or accidental characters of a growth may be propagated as well as the more essential, and thus it becomes important to know what part of a growth depends on a constitutional cause, and how much on a local, and thus be enabled to arrive at a better knowledge of the term malignancy. Such a knowledge would probably unravel the nature of many remarkable cases bearing upon the malignant nature of bone, cartilage, villous structures, pigmentary matters, &c., and explain how many of such structures are in one case harmless, as enchondromata and exostoses, and in another are merely additions to true cancerous growths. If these secondary characters can be propagated, as they seem to be, a very important field for observation is opened to us, for it shows that although malignancy may be due to some vice in the constitution, yet that the seeds of disease can be propagated from a local source. Now, if some of the characters of a tumour are clearly propagated, it would be difficult to say what limit can be put upon those structures which are and those which are not propagated. If a bony tumour on the leg determines the growth of bony tumours in the lungs, and if such spring up after the removal of the local disease, it shows that the constitution must have been previously contaminated by the materies morbi, and if so, it would appear that there might have been a time in which a removal of the primary growth would have prevented the subsequent production. It may be that the system is affected at a very early period, but nevertheless there must have been a time when the growth had not sufficiently developed itself to receive its local character; and therefore we repeat, if some characters of malignant disease seem evidently gained from a local source it shows clearly that propagation does take place from a diseased part, and then the question arises, to how great a degree? We

are quite aware that the practical tendency of surgeons has of late years been quite opposed to this doctrine; they have believed that a tumour which propagates, shows a constitutional morbid condition, and that therefore the removal of such local disease is useless; their practice of late years has been to interfere less with such forms of growth, and for this reason; that the mere appearance of a tumour to the naked eye or microscope is not considered altogether sufficient for a judgment as to its malignancy or not, but that the return or propagation of a growth is rather to be regarded as a principal sign of its malignancy: it is therefore clear that if the nature of a growth is rather to be determined by its propagation or not, it is assumed that a cancerous tumour will always propagate itself. We think surgeons have hitherto practised on an assumption or foregone conclusion, and that the character of a disease has been judged of by its tendency to return; and that the non-return has been sufficient to determine its non-malignancy. We should remember, at the same time, how cancerous tumours have remained local for years, and then spread. In cases of malignant fibroid, several years have elapsed before the infection of internal organs, and therefore it is not too much to presume that a removal of the diseased structure might have been its complete eradication. It should also be remembered in judging of the malignancy of a growth by its propagation through the body, that the disease necessarily differs in fatality according to the importance of the organ affected; how often, for example, have we seen a tumour of the brain called innocent because it was the only one found in the body, the physician forgetting that in a cancer of the breast a tumour would have been longer growing before removal, and yet even at that time the remaining organs were healthy. We must endeavour, therefore, by a careful examination of growths, to see how far they resemble those whose nature we know; and if, for example, we remove a tumour which resembles cancer in all particulars and no propagation of the disease follows, it is an assumption to say that the growth could not have been malignant because there was no return. We think the dogma of some writers on this matter is anything but satisfactory. We would, again, allude to the subject of pyæmia, to show how, in a previously healthy subject, the results

of a local change, produced by an accident, can be propagated through all parts of the body. A study of the distribution of morbid growths in connection with a supposed malignant diathesis may well be associated with that of pyæmia or the distribution of the elements of pus or some allied morbid material through the blood. That propagation takes place from one part to another, as cause and effect, and not both from one central influence, even in the most malignant diathesis, all will allow, else why the affection of the neighbouring lymphatic glands in mammary cancer before any other part, of the lumbar glands in carcinoma of the testes, of the liver in cancer of intestinal canal, &c. The subject has yet to be carefully considered; we do not wish to speak dogmatically, but we think many of the views now held respecting can cerare far from being proved; we allude especially to its being a distinct entity, or some foreign matter in the system, which nothing can eradicate. To attribute cancer to a constitutional cause and yet to state that cancer may remain local for a length of time or not return after removal, may appear contradictory, but we must remember that it has not yet been shown that the disposition to cancer may not change for a better one. We see no more *à priori* reasons against it than against a tuberculous disease being arrested; and, as regards a decay in a cancerous tumour and its non-propagation in consequence, we think this not unfrequently happens. We have witnessed the case of a man with cancer of the stomach who has lingered on much beyond the anticipated time, and which has appeared to be due to a decay or drying up of the cancer when its multiplication or increase was rather expected.

The consideration of cancerous propagation with pyæmia, reminds us how difficult it is to define the character of a malignant or cancerous growth, and how, in fact, new growths or tumours insensibly approach ordinary inflammatory deposits. A few instances showing the connection between the two, will aid in a proper judgment of the subject before us. The difficulty in assigning the true name to a deposit is seen especially in fibrous exudation, and this clearly shows, we think, that the distinction is not so clear as has been assumed. We have hitherto looked upon a tumour as a growth, whereas, a fibroid mass resulting from inflammation, has been regarded as lymph

subsequently organized, or becoming assimilated to the adjacent healthy parts; but we think the chronic changes in the various organs are as deserving the name of growth, as is the class of tumours. We are aware that this is a subject on which pathologists are divided, the process by which organization of lymph takes place after acute inflammation, for instance, in pleurisy or pericarditis; but in chronic changes or chronic inflammation, as it is styled, the new material grows, being not preceded by an effusion. In the case of a man who died of cirrhosis of the lung, and whom we watched during a period of five years, there never was any symptom or sign of acute effusion, but of gradual conversion of the pleura and lung-substance into fibrous tissue. This gradual thickening of the serous membrane has an analogous instance in the case of a bursa over the knee, whose walls may gradually increase, until a solid tumour is formed. Now this is a serous sac, quite analogous to the pleura and pericardium, and the similar changes occurring in all of them, assume the name inflammation in the latter, and a tumour in the former. As a result of inflammation of the heart, we have what is called the fibroid change or degeneration of the muscle; and in one case the mass of fibrous tissue was so large and so circumscribed, that the name tumour was given to it. We have examples also of the same in cirrhose of the liver, in which we have seen large portions of the organ converted into fibrous tissue, and quite circumscribed; and in other cases in which syphilis has been the supposed cause of the disease, the deposit is so defined, that the term tumour is as applicable as it would be to a cancerous tuber. In the brain it is especially difficult to draw the line between the inflammatory product and a tumour. In those cases where a quantity of new material, in the form of nucleated fibre, is found occupying a portion of the cerebral structure, it is difficult to know whether it were more correct to name that a tumour, or an inflammatory product; and our opinion is, that in many instances the difference is only one of words, and a more correct idea would be had, were they considered as one. We think, for instance, that an injury produced by a certain amount of violence which should set up an acute inflammation with the ordinary products, as pus, &c., would, if the injury were less violent, set up a chronic process, resulting

in its peculiar products, and constituting a tumour; and this has a practical as well as a theoretical bearing, as the following case, which lately came before us, will show. A policeman, after receiving a severe blow on the head, began in the course of some weeks to manifest cerebral symptoms, which, slowly progressing, terminated fatally at the end of a year. The nature of the injury had suggested to one medical man an abscess, but we thought, from the mere history of the case, relative to the duration, apart from the symptoms indicated, a chronic inflammatory result, that is, a tumour, and such was found. If we look to the bones, we see the same difficulty in drawing a line of demarcation between inflammatory products, exostoses, and tumours; the distinction, according to the names given in museums, appearing to be quite arbitrary. In the calvaria the projections often seen internally receive various names; and in the ends of the bones in contact with diseased joints, and which have been implicated in the inflammatory process, the term exostoses is frequently given. A case we lately witnessed presented this difficulty: a lad's thigh was amputated for disease of the knee, and around the head of the tibia there were a number of inflammatory products in the form of lymph and bone, and amongst these large masses of cartilage; and we felt to call the latter one of the results of the chronic change in the bone, or an enchondromatous tumour, would be equally correct.

We will now allude to another branch of this subject, referring to the connexion of the various products of disease, not merely to the outward form in determining a name, but to the character of the material which is produced. The best example may be found in the peritoneum; and let the case be as follows:—a patient has for some weeks or months been suffering from chronic disease in the abdomen affecting especially the peritoneum, with or without jaundice or ascites; and a post-mortem examination is made. The whole serous surfaces are more or less united, and covered with small granulations, and probably mesentery and omentum infiltrated with the same material, and the question arises, what is the nature of this deposit, is it inflammatory, strumous, or cancerous? (assuming that these are the only deposits of this form which can occur.) In very many instances we can decide,

but not always, and this occasional difficulty no doubt arises not from any want of appreciation of peculiarities on our own part, but from the fact that a transitional case is being regarded. In the case which we call cancer of peritoneum, there is generally no appearance of cancer in any other part of the body, but inasmuch as the omentum is much thickened and indurated; and the granulations are composed of well-formed nucleated cells, we call it cancer, particularly if ascites or jaundice be associated from implication of Glissons' capsule around the hepatic ducts and blood-vessels. We call the disease tuberculous if there be less infiltration of the structures, the deposit softer and yellow, and the cells ill formed; and more particularly, if the mucous membrane of intestine be affected, or the lungs. Occasionally, however, we meet with a case without these complications, and then the difficulty arises as to a name, and we are convinced that such a form of disease shows that no distinct line can be made between them. Only lately we witnessed the case of a boy who received a blow on his side producing fatal pleurisy, and the lymph on the serous membrane consisted of a number of small, yellow, granular masses, composed of ill-formed cells, and which might have been regarded as strumous deposit. We need not mention any examples of the well-known tubercular peritonitis, but briefly allude to the cancerous peritonitis.

Wm. P., æt. 60, ill ten weeks with pain in abdomen and emaciation, followed by some ascites and jaundice. After death the peritoneum was found covered with hard granules, and the omentum and mesentery were infiltrated with the same, producing much thickening and induration. Also thickening of Glissons' capsule, causing obstruction to hepatic ducts and portal vein. No disease elsewhere.

Stephen T—, æt. 72; ill five months with swelling of abdomen and legs. Sanguineous effusion found in abdomen, and peritoneum covered with numerous white tubercular nodules. Much of the exudation was no doubt simply inflammatory, but the more solid material was styled cancerous.

Mary Ann C—, æt. 46; ailing eight months with pain and

swelling of abdomen, and was tapped three times. Much recent lymph, but peritoneum covered with a black pigment, very much thickened, and having upon it numerous nodules, which were at the time styled cancerous. No disease of lymphatic glands. All these are instances of what is called cancer of the peritoneum, which constitutes, in extreme forms, a disease worthy of a distinct name.

The following case, not very much unlike the preceding, we preferred to call chronic peritonitis.

Mary J—, æt. 40; ill for several months with pain and swelling of abdomen, accompanied by general wasting. After death the whole serous surface was covered with granulations, and the intestines and various viscera united by lymph. The first appearance of the abdomen suggested the name tuberculous, but the absence of all tubercle in mucous membrane, lungs, &c., precluded this; moreover, the want of infiltration of omentum, &c., as in the above cases, prevented it being classed with them. We therefore styled it simply chronic peritonitis. The case, however, shows the difficulty which often exists in giving an appellation to a disease.

We might allude to other instances exemplifying the connexion between these deposits, especially in the lung, where it is difficult to draw a line between tuberculous and ordinary inflammatory material. Indeed in this organ, in speaking of phthisis and chronic disease, we are forced to place acute inflammatory product at one end of the scale and tubercle at the other, but find it impossible to draw a distinct line between them, seeing that there are numerous grades of disease intermediate.

In speaking of tubercle, we are led to mention another product of disease, the lardaceous or waxy material, as we think this holds some intermediate relation between tubercle and fibroid deposit. In several cases of this disease, given in a former volume,[1] it was seen that the patients suffered from scrofulous disease, or actually had tubercle in some organs of the body, which naturally suggests the idea of a close connexion between them, or that one is a modifica-

[1] 'Cases of Lardaceous Disease,' series iii, vol. ii, p. 103.

tion of the other; and this idea is corroborated by the association of a gelatinous-looking material (the gelatinous infiltration of Laennec) in the lung with tubercle, and the same also in the lymphatic glands; indeed in the latter organs we know the chalky, cheesy, or purulent matter is often preceded by a simple lardaceo-albuminous material, or the latter in fact produces solely the enlargement. We think this material, although in its simplicity, is deserving of a peculiar name, yet is associated with other morbid products, and takes its place in the scale very near tubercle.

In our attempt to show that the nomenclature we give to the various products of disease is rather to impress the most marked of these on our own minds than to prove natural divisions, we cannot overlook the diseases of the skin. We do not allude to the ordinary inflammatory diseases, although even here the so-called typical cases are rare compared with the imperfect or compound ones, but rather to those which depend on adventitious deposits. These vary not so much with the anatomical elements as the circumstances under which they are produced, and the parts in which they are developed. Thus we have the elephantiasis of the West Indies, in which an infiltration of an albuminous material in the skin and subcutaneous tissue produces the so-called lepra tuberosa and anæsthetica. A very similar deposit appears to produce the leprosy of the Jews, and in subsequent absorptions and contractions which take place we have the various forms of disease mentioned by authors. A fibrous deposit, circumscribed and vascular on surface, is called keloid, and if affecting a large portion of skin and subcutaneous tissue, and a subsequent withering takes place, another variety of the disease is produced, not to be distinguished from the results of a burn or a phlegmonous inflammation. If a fibrous tumour should contain cells, and more rapidly grow, it may be called fibrous or scirrhous cancer; and such a case (as we have lately seen) may in its early stages be not distinguishable from the disease just mentioned. We might also allude to various forms of disease of the skin called lupus.

In connexion with skin, we may remark that fat may be a morbid production in a form diffused through the structures, and may also be circumscribed, constituting a tumour or

steatoma; and even this may have a malignant tendency, as a preparation in our museum shows, which returned twice after removal.

To recapitulate: Believing that the attempt to give some particular characteristics to one form of growth and name it cancer, and to another and style it innocent, is only a partial way of regarding new growths, which amount to many in number, we have endeavoured to take a general glance at morbid products of all kinds, and see how they pass by insensible degrees into one another. It may be true that each end of the scale of growths tends, in different directions, towards malignancy or innocency, or heterologous and analogous tissues, if these terms be preferred; that the former denote a vice in the system, and the latter a local perversion of nutrition. We think, indeed, the blood maintains in integrity the several tissues of the body, but that, if there be any local abnormal condition, arising for example from an injury, a so-called inflammation, with its products, results; and if the change in the part be chronic, a tumour may follow, the disposition still being towards the production of a tissue analogous to that near which it springs, the most complex probably being gland-tissue; but if there be some fault or vice in the constitution, the material thrown out cannot attain a highly developed form, but its tendency is to a rapid increase of a simple cell- or fibre-growth, which shall extend to a fatal result, although under some circumstances, as when near bone, the local tissue may be superadded, as in an innocent growth. We have endeavoured to show also how inflammatory products can scarcely be distinguished from malignant or scrofulous, as in the peritoneum, or how in several cases an inflammatory product might with equal propriety be called a tumour; how in the skin these various products pass by insensible degrees into another, so that names can be only affixed to the most marked forms, and how the same holds good with the great number of new growths styled tumours.

Acute and Chronic Disease.

Most of our writers on medicine have hitherto directed their especial attention to acute diseases, making these the types and the forerunners of the numberless changes to which the various organs are liable, looking upon them as the regular forms of maladies in which pathological changes may be best considered and scientific treatment adopted, while the chronic forms are the irregular, or those which result from the acute; and, showing that such opinions are not rare, we lately heard discussed at a medical society the importance of early treating acute disease lest it should become chronic, the idea being that the body in health is liable to sudden attacks of acute disease, and if the latter be not arrested a chronic affection is the result. Without denying that this may occasionally be correct, our own experience is so different that if the doctrine were reversed we believe it would be far nearer the truth—that disease is mostly chronic, and if not arrested will become acute. It is for the most part an assumption that acute disease may become chronic, and much more that chronic disease has once been acute, the latter in fact in most instances never having been preceded by an acute affection, the chronic change having been chronic from the commencement, the mistaken notion having arisen from the terms employed having reference to time, a disease at its commencement being considered acute, and after a time chronic; whereas the morbid changes in the two are different *in kind*, being in the latter slow in their commencement and progress, and unaccompanied for a considerable time by symptoms, and thus unlike the former. It has been a habit among us that when any change has been found in an organ, especially if that be of a fibrous kind, to attribute it to a former inflammation, but this is altogether an assumption, we ourselves having lately seen a cirrhosed lung with an extremely thickened pleura which had been progressing for five years, and which, having watched from the commencement, we are sure never had any acute origin, and yet it was thought by some that such *must* have been; and the same we believe is true of other chronic

diseases. A slow change of this kind does not result, as was formerly supposed, from an organization of lymph, but is rather allied to a growth, and such is necessarily slow or chronic from the commencement; for example, if the beginning of the process known as cirrhose in the liver could be appreciated after the first week of its progress, the change would be chronic, although a hepatitis with suppuration might be called acute if the disease had existed for twice or thrice the time.

We have only to regard the various forms of diseases daily before us to recognise how large a number are chronic, and if we are in the habit of examining our patients after death we shall also discover how many acute attacks are merely the sequel of long-standing diseases. Among the affections of the brain how many are chronic, or dependent on disease in other parts, as softening or affections of the membranes; and if a person suddenly falls with apoplexy, and is by popular expression said to have been cut off in health, the medical man knows that the vessel which ruptured in the cerebrum had been slowly progressing in its morbid changes for at least many months; and as regards acute inflammation of the brain, a large number of cases are associated with tubercles of slow formation, or result from disease of the bone (as of internal ear), except a few instances in children apparently connected with exanthematous disease, we ourselves never having seen but one case which could be styled idiopathic inflammation of the brain where no anterior cause was found to account for it. On the other hand, acute meningitis is very often the termination of chronic disease of the brain, as when tumours are present, and thus, as we at first said, the acute follows the chronic, and post-mortem examinations reveal to us acute disease as that which is fatal, and which has resulted from the chronic. As regards the chest, no doubt acute disease of pleura or lung does occur in healthy persons from exposure to cold; but to one such case, we witness twenty of these affections occurring in a lung previously diseased, as in phthisis; or if the organ be healthy, the patient is suffering from some other affection, as morbus Brightii; and thus it is, we think, that no deductions can be made with reference to the seat of pneumonia, or its treatment, from cases taken indiscriminately from the wards of the hospital and from the records of the dead. Without alluding

to hypostatic pneumonia (or the pneumonia of the dying), we see at least fifty cases of hepatized lung occurring as a part of other visceral disease to one case of idiopathic pneumonia. Although there are constantly cases of pneumonia treated in the hospital, post-mortem inspection has not revealed a single idiopathic case for more than a year past; and the same may be said of pleurisy, though to a less extent, as we think idiopathic pleurisy is more common; but even here the large majority of pleurisies are occurring in patients suffering from chronic disease. We will add to this bronchitis, and maintain that acute idiopathic bronchitis is a rare disease. In reference to the pericardium, we may remind the reader that acute idiopathic inflammation of this structure is almost unknown. If then, acute pneumonia and pleurisy occurring in healthy persons constitute the exceptional cases in which such forms of maladies occur, and other acute affections are still more rare, how remarkable it appears for some of our older writers to speak of acute inflammations in healthy persons as typical forms of disease, and those in which the action of remedies is to be studied. In considering the abdomen, nearly all the affections, as witnessed in this country, are chronic; and acute peritonitis, which might be called idiopathic, we have never yet seen. Hepatitis and dysentery are acute in tropical climates, but the changes in the liver, kidney, intestine, &c., as we in our country witness them, are mostly slow. Acute peritonitis in nearly all cases results from some lesion which is chronic in one of the organs which is covered by it, and arises from abscesses bursting into it, or perforations of the hollow organs, or from a local inflammation commencing in an ovary or other part propagating itself throughout the abdomen.

Should acute inflammations arise without a chronic change in this part, there is some constitutional affection implicating the fluids in the body; such as disease of kidney, which is often suddenly fatal by a pericarditis or peritonitis.

The disposition for disease to commence slowly and end rapidly or acutely, is nowhere better seen than in a phthisical lung: toward the apex, where the disease commenced, we see a vomica surrounded by dense tissue, showing the organization and slow process which characterised the commencement of the disease; as we proceed lower down we find deposit of a

softer character; still lower down, this resembles the material of gray hepatization, and below this again we often find an acute pneumonia which has carried off the patient.

We do not of course, in thus speaking cursorily on this subject, refer to diseases dependent on some specific cause or poison which may lay hold of any healthy person, as the exanthemata, but we allude rather to local inflammations, which, according to some of the older systematic writers, were regarded as the most common forms of affections, and might occur in any person—they thought that an arachnitis or pericarditis, or a peritonitis, might from such a cause as exposure to cold, be suddenly lit up in a previously healthy person. Now we are not aware that we have ever witnessed such a case, these acute affections being merely parts of some more general malady affecting the whole system, or attacking an organ previously diseased. This, as before said, is not altogether true of pneumonia, nor of pleurisy, which are constantly occurring from causes above named, although even these affections arise far more frequently in diseased persons. We may state then, in general terms, that disease of the various parts of the body is, as a rule, chronic, and that the acute affections are merely terminations of these, or are set up by them. We are quite aware of the objection, that observation in the wards and in the post-mortem room is of a different kind, and that the very fact of these remarks having been made on the dead is sufficient to show that such organic changes could not have existed in those who have recovered. A discussion on this point would too greatly prolong this paper, and therefore we will merely state, that the proofs of the existence of various diseases during life are slight compared with ocular inspection after death; and therefore if, for example, in every case of fatal peritonitis a prior cause is found to have produced it, we think the arguments are equally in favour of such cause existing in the cases which recover, as that the inflammation is altogether idiopathic. We should have liked, had space allowed, to have entered upon this subject more in detail, and illustrated it by examples; this we hope to do at a future time; at present merely pointing out to those who have not the opportunities of making necroscopic examinations, the result of our observations.

On the relative importance of Disease of the Aortic and Mitral Valves of the Heart.

In looking through our cases of heart-disease, and observing the histories accompanying them, we think we discern the reason for the difference of opinion entertained respecting the duration and relative importance of the two forms above mentioned. Judging simply from clinical experience we should incline to second the opinion generally held respecting them, that the mitral is the more severe disease, that is, that when the patient with this form of malady comes before us he is very often (at least in hospital practice) suffering from dropsy and other symptoms denoting speedy dissolution, whereas the patient with aortic disease speaks of symptoms which have had longer duration and less severity, and he perhaps leaves us again in improved health. Judging then from the duration of illness or loss of health, in the two cases, we conclude that the general opinion is correct as to the greater severity of the disease which has its origin in the mitral valve. If, however, we endeavour to discover the time at which the respective maladies commenced, we may readily arrive at an opposite conclusion, but then we are obliged to adopt a different method in the two cases. In the first place, we must inquire what is the origin of the two forms of disease. Our own records most fully corroborate the opinion that disease of the left auriculo-ventricular orifice has its origin in a rheumatic endocarditis, and that the disease of the aortic orifice is due generally to a strain on the vessel or valves, and occurs for the most part in men who are accustomed to work hard and use strenuous exertions with their arms. Disease of the aortic valves undoubtedly may arise from endocarditis, but in the majority of instances it appears to arise from the cause named; but whether this be from undue pressure acting on the vessel through the parietes of the chest, or whether from an over strain of the blood on the vessel internally, is a question not yet decided. We have then two classes of cases (of course with numerous exceptions) of valvular disease, that of the mitral and that of the aortic

valves, and since the former so generally arises during a rheumatic attack we generally date its origin to the time at which that occurred, whereas, in the latter case, we can do nothing but discover the duration of the symptoms, and date the commencement of the disease to their first recognition. In one case we inquire about the rheumatic attack, and in the other how long symptoms denoting cardiac disease have existed. In the majority of the latter cases, which are those of men who are sawyers, deal-porters, &c., and accustomed to great exertions, we find that the symptoms have existed only for two or three years before death; in some cases the time is longer, but this appears to be the most usual period for the progress of the malady; whereas, in the case of disease of the auriculo-ventricular orifice although we may not have a history of marked symptoms for so long a period, yet the patient may allude to some slight distress connected with the circulation for a period dating from a rheumatic attack perhaps twenty years before, though in many cases there have been no symptoms whatever. Judging from a large number of cases, we think the conclusion is correct, that the disease of the mitral valve has been for the most part of longer standing than that of the aortic; but then the question at once arises, because an inflammatory process was set up at the period supposed or even a contraction of the orifice then took place, does it necessarily follow that such an impairment of the apparatus occurred as to constitute it a disease, or make it productive of manifest symptoms which might be styled unequivocally cardiac. We think in all probability in these cases of contracted mitral orifice no great impairment of the orifice took place, seeing that no marked symptoms had been present, and we cannot even look upon the changes which may have occurred in the cavities of the heart as an indication of the duration of its existence. The enlarged and hypertrophied left auricle, and increase of right side of heart does not explain how long the contracted orifice has existed, any more than the enlarged left ventricle does the aortic mischief. This difficulty in knowing how long a contraction of the mitral valve has existed, recurs in every case met with; we date the first onset to the rheumatic attack, even should this have occurred several years previously; but then

the question arises, did the contraction altogether occur at that time, but that owing to subsequent conservative changes in the heart and generally diminished circulation, of which the mitral orifice is the measure, no symptoms of cardiac disease existed, or has the change in the valve been essentially chronic and progressing during several years, or was the alteration in the first place slight, and subsequently during the time of the last fatal illness the more important changes occur; whichever view may be taken, there can be no doubt that very important changes do take place during this latter time, such as chalky degeneration, alterations in the muscular tissue, &c., which necessitate regurgitation through the orifice and the more urgent symptoms.

In commencing to make these remarks upon this question we had intended to take the duration of the disease in the two classes of cases, and striking an average, show the difference between them. This, however, we shall not do, as it might lead to error, for reasons above named, and also because the history attached to the *post-mortem* records has been derived from other sources than our own, and the dates of the illnesses cannot be accurately depended upon; still, on looking through a large number of cases on which we can rely, the inference is as is stated —that taking the duration of the severe symptoms, or the time in which the patient has called himself ill, the disease of the aortic valves has continued for a longer time, that is two or three years, while that of the mitral only for a few months; and, on the other hand, as in the one case we have no knowledge of the existence of the disease otherwise than connected with symptoms, and we only date it back to their commencement, whereas, in the case of mitral disease we date it to an inflammatory attack which has generally occurred several years before, we find the opposite rule holds good, that disease of the mitral valve is of much longer duration before a fatal issue than disease of the aortic valves.

These remarks we think explain the different opinions which we have heard expressed respecting the relative severity and importance of the two lesions, but they do not solve the question; this we think can only be done by carefully watching several cases during many years. If, for example, in the two classes of cases, the time of onset of disease could be

accurately known, and the cases watched to their conclusion, some approach to accuracy might be obtained, though even then it is possible that slight changes might have existed for years without symptoms. We believe most physicians would admit that a regurgitation through the mitral orifice was more important than a similar condition of the aortic; but it is another matter how long the two affections may have been in process of production, and although the one may be a more important lesion than the other, and the disease more speedy when such lesion obtains, yet the process preceding this may have been of much longer standing, being in fact a slower change, the result of inflammation unattended by symptoms, while the other disease might be called accidental, and at once productive of slight disturbance. This we believe to be a fair conclusion from the result of our cases, not very precise we admit, but we are unwilling to add any greater weight to our statements by the addition of figures, our object being at present merely to afford an explanation of the different opinions which have been expressed on this subject.

Contre-Coup.

We find so mistaken a notion respecting the meaning of this term as it affects the head, especially amongst students, that we will briefly state our experience on the subject. A very general impression seems to obtain among the inexperienced that if a person receive a blow on one side of the head, and is found suffering from compression due probably to depressed bone or effused blood, and there is no apparent mischief at the part externally injured, that the fracture or effused blood may with equal probability be on the other side, as a result of contre-coup, and that a question may then arise as to which side operative interference may be employed. Now the facts, from the perusal of the cases before us, show that injuries to the head are mainly of two kinds—those produced by a blow from a weapon or small substance falling on the head, and those arising from a fall of the whole body from a height. In the first kind the fracture is circumscribed and the mischief to the cerebral structure

limited, and such cases form the majority of those which recover; in the second variety, when the person falls and the weight of the body is a measure of the amount of injury, or rather the momentum as the velocity is added to it, the fracture is not only greater, but the whole brain receives a shock which is the immediate cause of death. In both cases the skull may be fractured, the meningeal vessels torn and blood effused outside the dura mater, immediately beneath the seat of fracture, but in neither class have we ever seen the blow produce a fracture on the opposite side of the skull; and, indeed, in stating that the effects of contre-coup are never seen on the bones, we believe we are only stating what every surgeon of experience knows: the base certainly may be fractured from a fall on the vertex, but this is by direct continuance of the force rather than by contre-coup. Now as the laceration of the meningeal vessels occurs in most cases from direct injury or fracture of the bone, it follows that effusion of the blood can rarely take place on the opposite side of the head between the dura mater and skull; at least we have no such case on the records before us. We certainly now and then meet with cases of effused blood outside the dura mater, arising from injuries where no fracture can be detected in any part of the skull; and therefore it is possible for this to occur on the side opposite to where the bone is broken. It is, however, certainly rare without fracture, and such a case we have never yet seen (although we have read of such), that is, of an injury to one side of the head producing an effusion of blood outside the dura mater productive of symptoms on the other. What are then the effects of contre-coup? These are limited almost entirely to the brain, and they are seen mostly in the cases of persons who have fallen from a height, or been thrown upon their heads, where the results very much resemble one another. For example, a man is thrown out of a vehicle on to the stones and receives a blow on the side of the head towards the top, the bone is found fractured at the part injured, and the fissures generally run to the base, and there is often blood effused between the dura mater and cranium, the former having been injured by the portions of detached bone. If this be so, owing to the connexion between the membrane and bone, only a partial separation

takes place, and a circumscribed clot of blood is formed, which produces compression: this is the condition the surgeon hopes to relieve by operation. In such a case we find the brain opposite to the fracture, that is, on the other side, and which is generally the lower part of the middle lobe ecchymosed and covered with effused blood, the latter may or may not have passed from beneath the arachnoid. The brain and pia mater have been lacerated, and a layer of effused blood is found at the base of the brain and surrounding the medulla oblongata. If in great quantity it may pass up the sides of the cerebrum and even by the fourth ventricle into the lateral ventricles: the blood in these cases is seldom in so large quantities as in sanguineous apoplexy. Now what does a surgeon propose to do in an operation on the cranium on account of injury? Removal of depressed bone, or release of effused blood; if the latter, it is the circumscribed mass of blood before mentioned, between the skull and dura mater, and which, as before stated, we have never seen except immediately beneath the injured part, never on the opposite side. What, therefore, would be his reasons for trephining on the side opposite to the injury; it would be, in the great majority of cases, in order to incise the dura mater, to let out blood derived from a lacerated brain, and to accomplish this he would be obliged in many cases to cut also the arachnoid, as the blood might be wholly in the subarachnoid space, and often even be obliged to put the patient in a depending position to allow the blood to run from the base, where it mostly collects, if, indeed, this be not its source. If the surgeon place such a condition before his mind, and determine that effused blood in such a situation is producing more mischief than the injury to the brain which caused it; and he believe such operation reasonable, no objections founded on the mere inspection of the dead can be of avail, though, judging from the many cases before us, we should think the injury to the brain was of equal importance with the effused blood, admitting at the same time that the presence of the latter in large quantities, by its pressure on the medulla oblongata, is often the cause of such speedy death as we sometimes witness. We should think, however, such operation extremely hazardous, but we cannot call to mind such an one from our own

experience. It might be said that cases sometimes occur where, after injury to the head, a hemiplegia has been observed on the same side of the body indicative of a severe lesion on the other; this is true, but what, we may ask, produces paralysis of one side of the body, but, according to our present knowledge, an interference with the function of the central parts of the brain, and this arises in cases of accident from two causes only; a direct injury to these parts (and which we have seen producing an effusion of blood within them), or a pouring out of the blood on the surface which shall affect these same parts by its powerful pressure on the hemisphere. Now as the latter rarely occurs except in fracture of the skull (at least in our experience), and as a fracture does not arise from contre-coup, the hemiplegia in such a case would most likely arise from an internal injury, and therefore an operation on the side opposite to the blow would be scarcely admissible. The cases, we believe, in which surgeons have most success are where symptoms of compression slowly come on after an injury, showing a slow effusion of blood, and an operation is performed at the seat of the blow to remove blood from surface of dura mater.

We should have been careful in hazarding any opinion respecting a surgical operation did it not naturally flow as a practical inference from the statement we had to make in respect to contre-coup, and the effects of which appear to be so strangely mistaken by some students and medical men; as we gather from remarks let fall as to which side it is better to trephine after injury, as if a blow on one side could produce a fracture on the other, or at least an effusion of blood remediable by operation. Our cases show simply that the former never occurs, and as blood is rarely effused on surface of dura mater (the condition which suggests an operation), except by injury of the latter by broken bone, it follows that trephining on the opposite side to injury can be scarcely ever admissible, excepting, indeed, it be as we before said to incise the membrane, and allow blood to exude from a contused brain. We may state that during a great many years we have never yet seen a case on the *post-mortem* table where an operation on the side opposite to that injured could possibly have given any relief.

Chronic Rheumatic Arthritis.

We had prepared a short paper on this disease for the present volume, but the treatise of Dr. Adams has so exhausted the subject, that it is rendered no longer necessary. The materials, indeed, would not have been furnished by the *post-mortem* records to which we are now referring, as we have only occasionally met with the disease on the recent subject, but we should have been guided by the light afforded from the numerous specimens in our museum, having lately been carefully cataloguing the diseases of the bones. Some of these are very admirable, although the series is not complete; but we number no less than 30 specimens of the disease as it affects the hip-joint, 9 of the disease of the shoulder, 5 of the elbow, but scarcely any of the other joints, together with four or five doubtful specimens of the disease of the vertebræ and the pelvic articulations. Our object in wishing to draw attention to this subject was that the disease might be recognised during life, for it is a remarkable circumstance that this affection appears altogether unknown among many surgeons and physicians, or is confounded with rheumatism and gout, and even those who are familiar with the disease, as seen in our museums, do not place it in their nosology to be looked for during life, and we must state even more than this, that the nature of the affection, even when the morbid structures are dissected, is so little understood that we repeatedly have specimens sent to us of this disease which has been considered the results of injury, and it is for the sake of those friends who have thus obliged us that we thus briefly draw attention to this interesting disease.

The first question which would no doubt be asked respecting it is—What is its connexion with rheumatism, and why has it the name rheumatic? We do not know from our own experience that the disease has anything to do with rheumatism, excepting that the joints are affected, and there can be no doubt that several distinct names are required for the various chronic diseases of the joints, as they consist of chalky concretions, increased secretions, &c. As the connexion of the

disease under consideration with rheumatism is not established we think the name chronic arthritis much more preferable, for the relation between it and acute disease of the joint is the same as between all other acute and chronic disease. We do not allude to a simple affection of the synovial membrane, where an acute synovitis is represented by a hydrops articuli, but to an ordinary destructive inflammation of the whole constituents of the joint; in a case where the synovial capsule is covered with lymph, cartilages destroyed, and a deposit of lymph at ends of bone disposed to become ossific; a chronic change of a similar kind would produce the so-called chronic rheumatic arthritis, which will be better understood by reviewing some cases of the disease before us. We may remark that a new name would be highly beneficial as directing the mind of the profession to a subject which would be fresh to many of its members. In explaining the peculiarities of this disease to students we have always made use of a very simple illustration of the following character:—Suppose a joint should be taken, and the articular cartilages removed, and some soft osseous material placed between the ends of the bones and they be squeezed together, this soft matter would arrange itself around the edges of the bones, and forming irregular projections, would, when hardened, form large expanded surfaces, and these, rubbing against each other, would at length receive a polish. More or less of these appearances are seen in all joints affected with the disease. In the hip, for example, in the affection long known as malum coxæ senile, we find the articular cartilages destroyed, the ligamentum teres also gone, and the head of the bone of the most irregular shape, from a quantity of new osseous matter deposited around it, producing a form like a mushroom; also the neck of the bone wasted, and so shortened in some specimens that the head of the os femoris forms a large rounded mass of bone, applied almost directly to the trochanter. In a corresponding degree the acetabulum is deepened and enlarged by a quantity of new osseous material around its margin, and often distinct portions of bone are found in the capsular ligament. The new bone, together with the articular surface, forms a very irregular layer, having many depressions and elevations; and the latter, by constant attrition,

become hardened and highly polished, or are eburnated, having undergone the ivory or porcellanous change. Although the density of bone varies so much under morbid circumstances to the naked eye, yet the microscope does not discover any very marked differences; it has been stated that in these dense portions of bone the Haversian canals are not developed, but of this we are not yet quite sure.

The *shoulder* is the joint next in frequency affected, and here the disease has the same characters as in the hip, modified according to the different anatomy of the parts. The head of the humerus becomes changed into an irregular mass of bone, and in less degrees of the disease it is seen to be altered in shape by the deposition of new bone on its outer side and above, and thus it comes into contact with the acromion. The clavicle also presents sometimes a smooth, articular surface where it meets the enlarged head of the humerus. The glenoid cavity is expanded, and the under surface of the acromion is polished also to meet it. At the end of the acromion there is often seen a distinct piece of bone, and it is a question whether this is the separated epiphysis, or whether it is altogether a new production. This particularly deserves mention, for it was especially to draw attention to such cases that we offer these remarks on the disease, for two or three specimens in our museum, formerly styled fracture of acromion, are evidently of this kind; and only last year we had sent to us a scapula as a specimen of fractured acromion, because of a detached piece of bone at the end of this process, which was evidently not so, nor even a separated epiphysis, but a new production of bone at its extremity. We may here state that in this example, as well as in some others, this separate piece of bone is undoubtedly a new formation. When the disease has advanced to a great extent, the tendons surrounding the joint become implicated, or torn, and a dislocation may occur; and this is another source of fallacy as to the nature of the disease, an injury or dislocation often having been considered the cause of the appearance; and this we think may often be so, at least in those instances where there is a distinct history of a fall and severe injury, as in some cases from which our specimens are taken. In many old preparations,

with no history and very great alteration in the form of the joints, it is difficult to say what the exciting cause of the change may have been. Such specimens are generally considered to represent the result of dislocation.

The third most frequent seat of the disease is the *elbow,* and here the disease is essentially of the same character as in the other joints. In a specimen we lately examined, from a fresh subject who died in the hospital, there was an addition of new bone along the edges of the articular surfaces, particularly along the edges of the ulna, and also as a rim around the head of the radius; in the humerus the new deposit was in separate pieces, in the capsular ligament, and only partially united to the bone; the movement of the joint was very limited, as shown during life, and here we may remark that the character of the disease was very evident before the part was removed on account of the ridges felt along the edges of the bone, and this was sufficient to contra-indicate anchylosis, a condition, we may observe, which never occurs in this disease, impaired motion being due to the altered condition of the articular surfaces, and not to any union between them; so far from there being any disposition to this, the surfaces are highly polished. In the specimen above referred to, although the disease was not far advanced, the articular cartilages had quite disappeared, and the ends of the bones were highly polished. In some of our specimens the number of small pieces of bone in the capsular ligament is very remarkable. We have two specimens with loose bones in the olecranon cavity of the humerus, and there is a question as to their nature; they have been called sesamoid bones and other names, they probably have some relation to the form of disease under consideration, but in the absence of all affection of the interior of the joint this is doubtful.

Judging from our own experience, and especially from specimens in our museum, we should say that the disease was much less common in other joints. In the case just referred to, where the elbow was affected, the knee was in a similar condition; there was but slight motion in it, and ridges of bone could be felt surrounding the condyles and head of tibia; our museum only shows one example of this and one specimen in a smaller joint.

We have no doubt that now attention is drawn to this form of complaint, it will be more frequently recognised; we believe we have seen it for several years past in many of those cases which are loosely styled chronic rheumatism, or rheumatic gout. As before said, its connexion with rheumatism is extremely doubtful, for it appears to us chronic arthritis is a much better name, as it bears the same relation to acute destruction of the joint as other diseases bear to their corresponding acute affections. Thus, a disease of the joint resulting in deposit of lymph on the synovial membrane, in loss of cartilage, and exudation in ends of bone, would, if chronic (that is, if the changes were of a very slow kind), terminate in thickening of capsular ligament, with osseous deposit in it as well as on the ends of the bones, in destruction of cartilages, the ligamentum teres in hip, just as is seen in this disease, which, we may here remark, occurs mostly in men, and seldom except in those advanced in years.

In studying the frequent changes in the *vertebræ*, their union and bony exudation, it has often occurred to us whether these are connected with the disease under consideration, or due to other causes. We refer to those cases where there is no complaint during life; but where, on examining the spine after death, we find the edges of the vertebræ united by a piece of bone projecting from the position of the intervertebral cartilage. If many vertebræ are thus joined, we have the appearance of a new strip of bone lying on one side of the spine, and holding it together. It has been called ossification of the anterior ligament, or intervertebral substance. In most cases the connexion of the bones is quite superficial, the intervertebral substance remaining healthy. This form of disease is often seen in the comparatively young, especially on the concave side of the spine, if there be a tendency to lateral curvature; and being quite unassociated with any affection of the limbs, we have always hesitated in associating them together. We have seldom observed it excepting among hard-working men, and here it is so common, that there is an equal probability of its presence as not; during the last year, for example, we have met with it thirty or forty times, in greater or less degrees. After removing the viscera from the body, and passing the hand down the spine, a

number of projections are felt on one side or the other, corresponding to the intervertebral substance, and thus uniting the vertebræ superficially together. There may be only two or three affected, or a layer of new bone may be seen covering the whole length of dorsal and lumbar spine, as if some soft liquid osseous matter had been poured over them, and this had subsequently hardened. We may remark, that a similar condition found in two cases by the late Mr. Aston Key, was supposed to have given rise to paraplegia by pressure on spinal cord, but the common occurrence of the affection is quite sufficient to negative such an opinion. Occasionally we meet with cases where the articular surfaces of the vertebræ are expanded, their edges covered with new osseous material, and the cartilages partly destroyed. Such may be considered examples of chronic rheumatic arthritis, as the alterations correspond to the conditions seen in other joints, but the absence of all affection of the other articulations and the union of the bones is sufficient to show the distinction between it and the very common affection of the spine to which we have alluded. It may be, however, that the same form of disease might affect different bones differently; and thus, although there is no disposition to anchylosis in a highly moveable joint, the superficial deposit might form a junction in a less mobile part.

The same remarks apply to the *pelvic joints*. Our Museum contains several specimens of pelves, where the articular surfaces of the pubes and sacro-iliac synchondroses are destroyed, and their edges covered with bony deposit; these deposits on each side, in some instances, partly unite. How far this affection is connected with chronic rheumatic arthritis we cannot at present say with certainty.

ON THE OPERATION

OF

OPENING THE URETHRA

IN THE

PERINÆUM.

By THOMAS BRYANT.

There have been few subjects of late years which have excited more discussion or difference of opinion than the one we are about to consider; and there are certainly none which have been so much influenced in their consideration by professional acrimony and personal feeling. This unfortunate and deplorable fact has doubtless led the minds of surgeons away from the true points at issue, and both those who advocate and those who condemn its practice have been too much swayed by party feeling to form a just estimate of the value of the operation.

That such an operation is both valuable and necessary in certain cases, most men now admit; and it is with the hope that I may be able to define the class of cases in which such treatment may be required, and to give some guides where such a practice is to be adopted, that I now take up the subject, which I shall illustrate by the notes of such cases as the experience at Guy's Hospital has yielded to me.

The opening of the urethra without a staff will be denominated "perineal section;" and with one "external division," or Syme's operation. The division of the urethra in the perinæum will include both.

In uncomplicated retention of urine from organic stricture, where the urethra will not admit the passage of a catheter, this operation is never needed; the more simple, expeditious, and safe one of puncturing the bladder through the rectum having superseded this comparatively severe measure. I have no instance where it was performed, nor do I know of any where it should be selected, and it may, I think, be safely stated, that in none is it required.

When retention is complicated with other injuries, such as extravasation of urine, laceration of the urethra after injury, either with or without injury to the pelvis, the operation of opening the urethra from the perinæum may be advantageously employed.

Extravasation of urine associated with organic stricture.—Commencing with the subject of extravasation of urine associated with organic stricture, I think it will not be disputed that the treatment of the surgeon should be directed to two objects: *first,* to let out the urine that is infiltrated into the tissue of the organs, as the perinæum, scrotum, penis, and abdomen, and thus prevent that fearful sloughing which is so well known to follow such infiltration; and *secondly,* to prevent its extension and recurrence, by removing the causes, and thus by some means procuring an easy and direct channel for the passage of the urine.

Before extravasation of urine could occur as a result of retention from organic stricture, it is tolerably clear that the urethra must have previously become obliterated, or at least impermeable. It is true this impermeability may be only temporary, being caused by some spasmodic action of the urethra upon the organic stricture; but more generally it is the result of the gradual contraction of the urethral passage. If this latter is the case, as with some certainty it may be asserted, there remains no doubt that the most simple, safe, and perfect operation is the "perineal section," as by it the urine extravasated into the perinæum is let out, a free passage for the flow of the urine from the bladder is afforded, and the chances of a fresh extravasation is prevented. If the stricture can be divided at the same time, an advantage is undoubtedly gained; but in many cases the infiltration of urine has so disfigured the parts, that much difficulty is experienced in tracing

the seat of stricture, and thus its division is rendered difficult, or, may be, prevented.

Many surgeons I know are satisfied by making simple incisions into the cellular tissue, thus allowing the urine to find its way out through these artificial channels; but such treatment I hold to be unscientific and only trifling, satisfying but one of the objects to be attained; the extravasation still continues, and its cause still exists, and although the evils by such treatment are certainly diminished, there are great ones left, and the extra severity of opening the urethra from the perinæum, either with or without a metallic guide to direct the incisions, surely cannot outweigh the advantages gained by such a proceeding.

If a grooved staff can be passed through the stricture, the simple operation called "external division" by Professor Syme may be employed; but if such a measure is impossible, the more formidable operation of opening the urethra without such a director must be performed, and the simplest and best method is as follows.

Having placed the patient in the position for lithotomy, pass the finger of the left hand into the rectum, and apply its point to the anterior margin of the prostate and membranous portion of the urethra; the integument of the perinæum may then be divided in the median line, and a straight knife, with the edge turned upwards, passed directly backward to the apex of the urethral triangle, the finger in the rectum indicating exactly the extent; the incision may then be made upwards, and the canal freely opened and stricture divided. By this means the finger becomes a good director, and the urethra cannot fail to be opened. This operation is far superior to the ordinary one of cutting down directly upon the urethra, when no metallic guide can be employed, and should certainly be selected.

In cases of laceration of the urethra from an injury to the perinæum, where no extravasation has taken place, there is no question that the passage of a catheter, when it can be accomplished, is the simplest and best treatment, leaving the instrument in for three or four days. But, in many cases, such a practice is impossible, the most skilful hands fail to find the opening to the lower portion of the lacerated urethra, and, as a

consequence, unless some steps be taken to let out the urine, extravasation must follow, with all its dangers.

The question then for determination is—what is the best step to be taken? And I answer most unhesitatingly, the "perineal section." By such an operation the extravasated blood is let out, the chances of the extravasation of urine are removed, and, what is more, by the passage of a catheter and its subsequent rest in the urethra, a more complete and perfect cure is likely to follow than when the junction of the divided passage is left to chance, for it is from such cases that the worst and most intractable forms of stricture are produced, and in which a subsequent perineal division of the urethra is generally called for.

Case. I—J. B—, æt. 35, when jumping over a post injured his perinæum; the accident was followed by bleeding from the urethra and extravasation of urine. When admitted, catheterism was impossible; the urethra was laid open in the perinæum, and an instrument passed and left in for a week; the wound gradually healed, and the urine was drawn off regularly by a catheter, and upon the 17th day the perineal wound had ceased to afford any passage to the urine, and the man left well.

When this rupture of the urethra is associated with other pelvic injuries, the argument in favour of the operation is much strengthened; the dangers resulting from extravasation of urine would in such cases be evidently magnified, and the necessity for an easy and direct flow of urine becomes more apparent. By this operation such a result is easily obtained, and, unless a catheter can be passed, it should be performed.

When required in organic stricture.—Having thus briefly pointed out some of the cases in which the division of the urethra in the perinæum may be called for, I pass on to the consideration of the cases of organic stricture in which such a practice may be required, and without entering into the many points which have excited so much anger and dispute, I believe few surgeons will deny that there are cases where the

urethra is completely obliterated. The Museum at Guy's Hospital positively proves the fact.

With respect to the impermeability of the urethra, I will not say more, than that most surgeons do occasionally meet with cases where the passage of a catheter is a very difficult task, and at times impossible, unless the instrument is forced through all opposing structures; practically, such cases are impermeable, and are to be treated accordingly. The surgeon who has to treat finds an obstruction which he cannot fairly overcome, and although another may believe (and perhaps rightly) that in his hands the difficulty would be conquered, the fact remains that the surgeon who has to treat the stricture finds it impermeable, and he must consequently adapt his treatment to the difficulties with which he has to contend; and presuming that he is a competent man and of average ability, and remembering that surgical rules (as others) are for the many, and not for the expert few, I proceed with my subject, commencing with those forms of stricture which are permeable.

The following short conversation which I held with a Scotch gentleman who was visiting Guy's Hospital after a long residence in Edinburgh, may, perhaps, help us to understand the cause of the discussion which has been so violent about impermeable and obstructed urethras. Upon asking him many questions about the treatment of cases of stricture, and in what manner a case of impermeable stricture would be treated in the north, he answered by denying the existence of such a case; for, argued he, a stricture is merely a contracted canal. When the urethra is therefore closed, it is no longer a canal, and consequently cannot suffer from stricture. It was thus evident that, although we employed the same words, we meant very different things; and I venture to conclude that this is really the cause of much of the difference of opinion which has arisen upon this subject.

It may, perhaps, be fairly stated as a general opinion—"That in cases of organic stricture, where the passage of a catheter is possible and not difficult, where it does not produce either any injurious or painful constitutional or local disturbance, and where, after dilatation of the stricture, an occasional passage only of the instrument is required to main-

tain an open channel, no other surgical means can be called for." Such an opinion, I think, is fairly held by all surgeons, and any other treatment must require very great and positive evidence of its value, before it can be substituted for such simple means. But, unfortunately, such simple treatment is not sufficient for all cases of permeable stricture, and a second statement, I believe, may be made, which is as generally entertained as the preceding :

"That cases of stricture do occur occasionally which are so exquisitively sensitive, that the passage of a catheter, however skilfully performed, is followed by such severe constitutional and local disturbance, as to produce more harm than good, and in which it is clear some other method of cure must be employed. And others, which are relieved by means of the catheter and are even fully dilated, but which have a tendency to contract again immediately upon the omission of the treatment."

In the former case the treatment aggravates instead of relieving the symptoms; in the latter it must be continued for life, to preserve an open passage.

Under such circumstances it is clear that some other plan of treatment must be adopted, and I believe the most beneficial to be the "external division" of the stricture from the perinæum; and it is to Professor Syme that we are here especially indebted for having so ably recalled our attention to the treatment of such troublesome and painful cases.

Case of Irritable Stricture.

Case ii.—E. H—, æt. 28, was admitted with an irritable stricture of six years' duration; the passage of a catheter produced intense pain and constitutional disturbance, without affording any relief. "External division" of the urethra was performed, and an elastic catheter passed and left in for two days; upon the fourth day nearly all the urine passed through the wound; upon the eleventh day the wound had nearly healed, and in one month he left well.

Contractile Stricture.

Case iii.—J. H—, æt. 39, had had stricture for nine

years, with frequent catheterism, and several attacks of retention; and five years previously his bladder had been punctured per rectum. Dilatation of the urethra was but of temporary benefit. "External division" of the urethra was performed, and a small calculus behind the stricture was removed; the catheter was left in for four days, and in one month he left well.

Case iv.—J. G—, æt. 29, admitted with stricture of thirteen years' duration. He had been relieved frequently by catheterism in different hospitals, and one year previously had been punctured per rectum. The operation of "external division" of the urethra was performed, and a No. 13 catheter left in the bladder. In six weeks the wound had quite healed, and he left able to pass his urine in a full stream.

Case v.—H. R—, æt. 44, with stricture of thirteen years' duration, was admitted for the purpose of being operated upon. His urethra was permeable and was not very contractile, but he had made up his mind to be "cut," and the operation of "external division" was therefore performed. The stricture was a very long one. In eighteen days the wound had ceased to allow the passage of the urine, and in one month he left well.

Impermeable Stricture.

Having thus disposed of those cases of stricture which are permeable, and which occasionally demand the operation of division of the urethra from the perinæum, I pass on to the consideration of those which are not permeable, and which may also demand the same operation.

In the majority of cases there is but little doubt that by constitutional means, such as perfect rest, opium, mild alteratives, and local depletion, the urethra will at last admit the passage of an instrument; and when this improved condition has been obtained, the treatment of the case becomes the same as has been just described under the heading of permeable strictures; but every now and then cases come before the notice of the surgeon where such a favorable result

cannot be secured, and, consequently, his treatment must be adapted to the wants of the individual case.

This impermeability may be the result of great irritability of the passage, of its gradual contraction, or of both combined; or it may result from perfect obliteration. Constitutional and local treatment may at times relieve some of these conditions, but occasionally all means fail, catheterism becomes impossible, and, as a consequence, some other plan of treatment must be adopted; and it is in such cases that the operation of dividing the urethra in the perinæum becomes of value.

Case vi.—The following case well illustrates the subject: Robert M—, æt. 50, who had suffered from stricture for six years, was admitted with a urethra which would not admit the passage of the smallest instrument, and the attempt produced severe local and constitutional disturbance. Chloroform was given, but the urethra was still impermeable; consequently the "perineal section" was performed, and a catheter left in for two days. The man progressed favorably, and left, after four months' residence in the hospital, cured.

Obliterated Urethra.

The cases of stricture in which the urethra is obliterated are certainly too hopeless to treat by catheterism, caustics, or any other such means. The hope of relief by the operation now under consideration is also not great, but it certainly offers the best chance for the unfortunate sufferer. It is not often that the urethra is ever wholly destroyed; some small portion of it is generally only involved, and by the operation of "perineal section" this portion may be remodelled to form a useful urethra.

Such cases, uncomplicated with perineal or other fistula, cannot be seen, as the urine must find its way out, and its general course is through the perinæum. Under the following heading, therefore, will cases be given to illustrate the treatment.

Organic Stricture with Perineal Fistula.

The next class of cases in which the operation of dividing

the urethra in the perinæum may be required, includes those forms of stricture associated with perineal fistula.

The fact of the presence of a urinary fistula, whether in the perinæum, scrotum, or other parts, does not necessarily render the treatment of stricture more complicated, as for the most part the fistula will heal when the passage through the urethra has become free. But as fistulæ are generally the result of abscess, or extravasation of urine, and as these seldom occur unless the urethra has become much contracted, if not impermeable or obliterated, the strictures associated with such a complication are mostly of a severe type, demanding, as a consequence, severer treatment; and the operation of dividing the stricture through the perinæum is not unfrequently required.

The presence of urinary fistula should not, then, much influence the treatment of the class of cases now under consideration; the condition of the urethra is the one important point to which our attention should be directed, as by treating and remedying its morbid conditions, we at the same time treat and generally cure the fistula.

The forms of stricture associated with perineal fistula which require division in the perinæum are the same as those previously described, viz., the irritable, the contractile, and obliterated urethras. In these cases, as a rule, the urethra is indurated and almost cartilaginous, the whole tissues of the perinæum, &c., are gristly from inflammatory induration, and the passage of the urethra is frequently completely obliterated, or so tortuous as to be practically impermeable. What treatment can be adopted? becomes then a serious question. Catheterism is impossible, and consequently the use of caustics, &c., cannot be employed, and I believe, the "perineal section" is the only surgical treatment. Let the urethra be opened, as previously directed, anterior to the prostate, the canal found, and stricture divided from behind. Let a catheter be then passed and kept in, and the subsequent treatment as in other cases. My note-book yields me many examples of such cases, and the following are brief notes of some of them.

Cases of Contractile Stricture with Perineal Fistula.

Case vii.—C. N—, æt. 32, admitted with stricture of ten years' duration, associated with fistula for ten weeks, has had occasional attacks of retention and much violent catheterism. The urethra could admit a small catheter, but after dilatation it immediately contracted. The operation of "external division" was performed, and a No. 11 catheter passed and left in for two days. Upon the sixth day urine flowed through the penis, and the man left in one month (as his health was failing) with the fistula healed, but the wound still discharging a little urine. A full sized catheter could be passed.

Case viii.—T. S—, æt. 35, admitted with stricture of eight years' duration and perineal fistula of two. The stricture was permeable to No. 1 catheter, and when dilated it contracted immediately. The operation of "external division" was employed, and he left cured in six weeks.

Cases of Obliterated or Impermeable Urethra with Perineal Fistula.

Case ix.—J. L—, a sailor, æt. 42, admitted with an impermeable and indurated stricture of three years' existence, and perineal abscess, was operated upon by the "perineal section," and a large catheter fastened in. The operation was followed by all the symptoms of pyæmia and secondary abscesses in the arms; but from this he perfectly recovered, and left the hospital three months after with a free urethra, but with a small discharging perineal fistula.

Case x.—A. C—, æt. 45, admitted with a three years' stricture, and with perineal fistula of six months' existence. The urethra was cartilaginous, and quite impermeable. "Perineal section" was performed, and a No. 12 catheter introduced; upon the ninth day some urine passed freely through the urethra, and in six weeks he left cured.

Case xi.—J. de M—, æt. 54, a sailor, with stricture of twenty years' duration, and with perineal fistula of nine weeks; with a urethra which was quite impermeable, and a perinæum

indurated and cartilaginous, was operated upon by the "perineal section," and a large catheter passed and left in for four days; he went on favorably, the induration disappearing, and the urethra becoming more patent, and he left in six weeks relieved, but with the perineal fistula still discharging.

Case xii.—W. S—, æt. 58, a labourer, who had suffered from stricture for eighteen years, and from perineal fistula for seven weeks, was admitted with an impermeable, callous, and obliterated urethra. "Perineal section" was performed, and a large catheter passed and left in for eight days. Some rigors followed upon the fourth day, with fever; but in six weeks he left cured.

Case xiii.—H. S—, æt. 55, admitted with stricture of twenty years, and with numerous perineal fistulæ of six months' duration, and with a riddled, impermeable urethra. "Perineal section" was performed, followed by slight bleeding, which was easily arrested. He left after two months' residence in the hospital with a patent urethra, but with a discharging perineal fistula.

Case xiv.—W. S—, a cachectic, intemperate man, æt. 45, who had experienced difficulty of micturition for twelve years, with frequent attacks of retention of urine, was admitted with extravasation of urine into the perinæum, scrotum, and penis, with several perineal fistulæ, and an impermeable urethra; all the urine flowing through the perinæum. The operation of "perineal section" was performed, the whole perinæum being quite cartilaginous; a No. 6 catheter being fastened in the bladder. In three months the man left convalescent, although a small quantity of urine flowed through the perinæum.

Traumatic stricture.—In a previous page, when alluding to the treatment of cases of laceration of the urethra from injury, I mentioned that it was from such that the worst and most intractable forms of stricture were produced; and that consequently the operation of division of the urethra in the perinæum was not unfrequently called for. The experience of most men will enable them to understand the truth of such a remark,

and the pathologist will be prepared for such a consequence, well knowing the constant tendency for all cicatrices to contract. In rupture of the urethra the line of the laceration is generally transverse; consequently, by the contraction of the cicatrix, the calibre of the urethra must be gradually diminished. Practically, the worst cases of stricture are the result of such an accident; and when the canal has so contracted as to become impermeable, the only efficient treatment is the division of the stricture in the perinæum. If a director can be employed, the operation of "external division" is the simplest; but if not, the "perineal section" must be performed. Of course such treatment is only necessary when dilatation has failed to produce any permanent effect.

Cases of Traumatic Stricture.

Case xv.—T. P—, æt. 30, one year prior to his admission, fell upon a spike, injuring the perinæum and urethra. The accident was followed by hæmaturia for one week, and difficulty in micturition, which has since gradually become worse. The canal is indurated, and catheterism very difficult, the stricture being hard and undilatable. The operation of "external division" was performed, and the man rapidly recovered.

Case xvi.—D. Q—, æt. 19, having fallen across a beam, seven weeks before admission, injured his urethra, and was subsequently seized with retention of urine and extravasation; the parts were freely incised, and since then nearly all the urine has passed through the perinæum. When admitted, the stricture was impermeable and cartilaginous. The operation of "perineal section" was performed, and a large catheter introduced and left in; and in six weeks the wound had healed, and the man left with a free urethra.

The two following cases of traumatic stricture are in boys, and in neither was the operation followed by success; and it would appear that in them it is not so applicable as in adults, although it is difficult to suggest a better plan of treatment.

Case xvii.—W. M—, æt. 13, having injured his perinæum

five months previously, was admitted with an impermeable urethra. The operation of "perineal section" was performed, and a catheter introduced; the wound, however, did not heal, urine flowing through it when he left the hospital, two months after.

Case xviii.—J. B—, æt. 14, fell across a beam, two days before his admission; the accident was followed by extravasation of urine, for which free incisions were made at the time, and the parts subsequently healed; upon the twenty-fourth day a catheter was passed for the first time, and he subsequently passed his urine in a good stream; the urethra, however, gradually recontracted, at last becoming impermeable. Upon the ninetieth day "perineal section" was performed, and a catheter passed and left in, but the parts still contracted, and he left two months after, with an impermeable urethra, and micturating through the perinæum.

Concluding Summary.

Conclusions.

1. In uncomplicated retention of urine from organic stricture, the operation of opening the urethra in the perinæum is not required, the more simple and safe one of puncturing the bladder through the rectum being preferable.
2. When complicated with extravasation of urine from any cause, it should be performed at once, and the stricture, when present, divided, if possible.
3. In laceration of the urethra from injury, when a catheter cannot be passed, the urethra should be opened.
4. And also when the above injury is associated with pelvic mischief.
5. Strictures are occasionally met with which are impermeable, and urethras which are obliterated.
6. That in cases of organic stricture, when the passage of a catheter is possible and not difficult; where it does not produce either any injurious or painful constitutional or local disturbance, and where, after dilatation of the stricture, an occasional passage only of the instrument is required to maintain an open channel, no other surgical means can be called for.

7. That cases of stricture do occur occasionally which are so exquisitely sensitive, and in which the passage of a catheter, however skilfully performed, is followed by such severe constitutional and local disturbance, as to produce more harm than good; and *others,* which are relieved by means of a catheter, and are even fully dilated, but which have a tendency to contract again immediately upon the omission of the treatment; in such cases the operation of "external division" is most valuable.

8. That the majority of cases of what are called impermeable strictures may be rendered permeable by constitutional treatment, but that some are undoubtedly impermeable; in such cases, the operation of "perineal section" is of value.

9. When the urethra is obliterated, the operation of "perineal section" may occasionally be demanded, particularly when associated with perineal fistulæ.

10. That the worst and most intractable forms of stricture are the result of injury, and in those cases the operation either of "external division" or "perineal section" is of great value.

11. That in boys the operation is not so successful as in adults, although no better can be suggested.

ON

OPHTHALMOSTASIS,

WITH

AN ACCOUNT OF AN IMPROVED METHOD

IN

EXTRACTION OF THE CATARACT.

By JOHN F. FRANCE.

Ever since the practice of extracting the cataract was introduced, the operation has been a favourite with the profession; and surgeons adopting it extensively have but been stimulated by its difficulties to combat and surmount them. Nor are these difficulties constant, supposing the requisite knowledge and skill on the operator's part. With subjects of a calm, tranquil, and confiding temperament, with a favourable relative conformation of the lids, globe, and orbital edges, and an eye generally healthy, the process is one of comparative facility. It is when these conditions are absent, when the patient is nervous and insubordinate, the palpebral apertures narrow, or overhung by a prominent brow, the globe sunk deeply in the orbit, and with involuntary motion wandering apprehensively in every direction and resting in none, or none convenient for the surgeon's purpose, when finally it starts convulsively from the knife, causing the aqueous humour to escape and the anterior chamber to collapse, at the critical moment when the instrument should steadily traverse the anterior chamber; in such circumstances as these it is that the primary difficulties of the operation are extreme. Between the two classes of cases every

gradation of course exists; and we have to encounter them as they present themselves promiscuously; while chloroform lends us no assistance, for we want consciousness preserved, and we tremble at the prospect of struggling or of sickness. The obstacles just enumerated are of course overcome daily by skilled and experienced men; but they do not the less exist, render in a measure precarious the accomplishment of the end immediately in view, and imperil the ultimate result; and could we in any way diminish the difficulties they occasion, and reduce the anxious and troublesome cases more nearly to a level with those on which it is a pleasure to operate, assuredly the gain would be substantial and great. To effect this is a problem which has exercised the ingenuity of departed worthies in the profession, and, ere offering my own solution, I propose to bestow a glance retrospectively at their efforts.

It is well known that Daviel, numerous as were the instruments he used,—a lancet-shaped knife to puncture the cornea at first, a blunt-pointed, double-edged knife to enlarge the wound each way, two pairs of curved scissors to give the section its complete dimensions (which with him were two-thirds of the circumference of the cornea), a small spatula to raise the flap, a needle to open the capsule, a curette and forceps to remove fragments of the lens and shreds of the capsule,—did not employ any artificial means of fixing the globe.[1] Though the corneal section was then, and long afterwards, always made downwards, in a situation the most accessible, yet it was early felt how conducive to success fixity of the globe during the process must be; and hence the very volume in which Daviel's memorable paper was given to the world contains the first suggestion, from another hand, for the attainment of this desideratum. A young surgeon, of the Hotel Dieu, named Poyet, devised, for the incision of the cornea, a long narrow knife, pierced close to its extremity with a little hole to carry a thread. When the point of the knife transfixing the cornea emerged on its nasal side, this thread was to be disengaged and form a sling to hold the eye stationary while the section was completed. As tested on the dead subject the contrivance was approved by a committee of the Royal Academy of Surgery;

[1] See 'Mém. de l'Académie Royale de Chirurgie,' 1752.

but on the living it proved utterly abortive, and was relinquished as such by its author.

Samuel Sharp, the eminent surgeon of our own hospital, was among the first to hail the new operation, to practise it, and attempt its improvement. His observations and the figure of the knife he recommended (but which is now disused) will be found in the Philosophical Transactions of 1753. In the latter of his two papers,[1] he says, "It is to be hoped that when extraction shall be more generally practised, ingenious men will render it still more perfect; and I should not be surprised if the use of a speculum oculi should hereafter be deemed an improvement; but then it must be contrived so as that it shall not compress the globe of the eye, or if it does the operator must be careful to remove it in the instant the incision is making."

Twenty years later, Joseph Warner (who for the unexampled period of forty-five years[2] trod the wards of Guy's, its equally distinguished surgeon), adverting to the same topic as his former colleague, wrote, "The common speculum oculi must not be made use of in this operation, since the compression from that instrument will be found to be so great as to squeeze out a part of the vitreous humour."[3] To appreciate the force of this objection it is requisite to ascertain the form of the now obsolete instrument referred to. A kind apparently long in vogue, and figured by Dionis,[4] is represented of reduced size in fig. I. It consists simply of a metal ring, meant to press on the front of the eye, mounted on a handle. Mr. Sharp himself had delineated a modification of the same instrument prior to the introduction of extraction.[5] It was capable of adjustment to eyes of differing volume, being so constructed as to provide for the enlargement or contraction of the metal circlet, by means of the division of the latter into two segments springing from a forceps-like handle, the blades of which

[1] November, 1753.

[2] From 1745 to 1790.

[3] 'Description of the Human Eye and its adjacent parts, with their principal Diseases, &c., 1773.

[4] 'Chirurgical Operations,' translated from the Paris edition. London, 1733.

[5] 'Treatise on the Operations of Surgery,' 1739.

were maintained at the desired distance by a sliding button and clasp. It is shown in fig. D. These instruments were not intended for application directly upon the globe, but upon the lids; and in order to keep the eye at once exposed and still by the metal ring embracing the cornea (with the intervention of so slippery a medium), very considerable pressure must necessarily have been demanded. No wonder, therefore, that Warner should deprecate their use in extraction.

Benjamin Bell concurred in this judgment of the old specula;[1] but, nevertheless, recommended, in the operation before us, the invention of a fellow-townsman, Mr. Miller, which I have copied in fig. G. In this appliance a flat, metal ring affixed to a handle was to press directly on the sclerotic around the cornea, and keep the whole globe motionless, while the superior lid was raised and held up on a curved plate, projecting like a cap-shade from the upper part of the ring. Mr. Ware, in his translation of Wenzel[2] (though coinciding generally in his author's discouragement of specula, who terms "inutiles les instrumens proposés pour fixer l'œil"), describes an instrument similar to Bell's and Miller's, only with an oval instead of circular ring, which he attributes to Mr. Else, and recommends, and himself used in particular cases. There is obviously, however, the same objection to this instrument of either variety as to the former, though in a less degree. Their redeeming plea was, that pressure might and ought to be remitted, (though the speculum could not be absolutely removed, the knife traversing in front of it), as soon as counter-punctuation was effected, and ere the section was finished; but that they were cumbrous is apparent, that they failed in the immediate object of fixing the globe, I much suspect, and most practical surgeons since Warner's time have extended his decision respecting earlier specula to this of Miller, and endorsed their condemnation. Their fundamental principle—compression—was, to say the least, pregnant with danger; and their universal abandonment argues that in actual employment they were found mischievous.

Of altogether different form, though involving the same

[1] 'System of Surgery,' Edinburgh, 1785.

[2] 'Treatise on the Cataract,' London, 1791.

vicious principle, if considered in relation to extraction, are the specula of Pellier, senior, fig. H., and of Sir William Adams, fig. I. (*a* and *b*), on which a few words in passing may be bestowed. The former, regarded merely in the light of a retractor to separate the lids and expose the globe, in various cases of difficulty from spasm and tumefaction, has deservedly held its ground to the present time; while for its other purpose of fixing the globe by pressure on the sclerotic, in common with Adam's which acted almost exclusively in this way (though not designed by its author for the operation of extraction, which he discouraged), it has equally deservedly fallen into disuse.

According to Sabatier,[1] and Pellier[2] jun., Beranger of Bordeaux (whose treatise, if separately published, I have not been able to trace), employed a double hook, (figured by the latter, and exactly resembling a two pronged fork with its sharp points curled round, fig. K.), wherewith to hold the conjunctiva, and so control the eye during extraction. He does not seem, however, to have enlisted any imitators.

The same author, Pellier de Quengsy, exhibits a complex kind of forceps, intended, after the completion of the section, to seize the edge of the sclerotic and attached margin of the cornea, and hold them firmly in cases where the movements of the eye impede the escape of the cataract. The proposed application of such an instrument would be peremptorily and deservedly condemned at the present day; besides which, it being designed for a different stage of the operation from that with which I am concerned, it need not on that account further engage our attention.

Le Cat recommended a peculiar kind of forceps known by contemporaries as of the Swiss form, and previously in use for extirpation of the mammary gland. I have not succeeded in discovering a drawing of this instrument, but conceive it to have somewhat resembled the "devil's-claw" forceps, formerly employed for excision of the tonsils or deep-lying tumours. The method of their application would almost seem to have been by clasping the entire globe between their long-toothed branches, a plan of procedure which, if actually

1 'Medicine Operatoire,' Paris, edition of 1824, vol. iv, p. 129.

2 'Cours d'Operations,' Paris, 1789.

followed, would well account for and justify their fate, narrated by Demours:[1] "Ces instrumens, qui ne remplissoient qu'imparfaitement les intentions . . . . . ont été abandonnés à raison de la *compression* qu'ils exerçoient sur le globe de l'œil." In reference to the same implement Aug. Gottlieb Richter, from whom I have drawn the above description of it, had written:[2] "Le Cat forcipe usum fuisse scimus . . . . . . Cum autem hæc instrumenta tunicæ oculi conjunctivæ infixa dolores creent, quos culter in cornea vix creat, *oculumque male mulctent, ut inflammatio ingens interdum cum nova et insanabili visus privatione suboriatur* semper quoque metuendum sit, ne illorum usus vel *premendo* vel irritando humores expellat, facile intelligitur, *tam periculoso auxilio* ad motus illos cohibendos opus non esse. Accedit hæc instrumenta cultello sectionem corneæ peragenti, imprimis in oculis profunde in orbita latentibus, impedimento plerumque esse." From these extracts it is apparent that, whatever were its precise construction, Le Cat's instrument was in itself, or in its method of application, a very formidable affair; and something very different from that which I have myself in the sequel to introduce.

Pellier put forward another instrument (fig. L), quite within the scope of our present inquiry. His "crescent," so called from the shape of its extremity, was intended to be applied on the inner side of the globe, near the margin of the cornea, to maintain the latter by counter-pressure in a favorable position, while the knife was piercing and dividing its texture. To give the crescent a better hold upon the eye, its concavity was furnished with dentated projections; and to promote the convenience of the operator, the shaft was made of varied curve, and the extremity fixed thereon at different angles. The main idea of this appliance, however, was not novel. It was in effect a modification, and in some respects an improvement, of Pamart's lance, an instrument to which I shall refer again presently, but never seems to have gained the acceptance which the latter met with.

It is open to palpable objections on the ground of inadequacy to its purpose on one side, or of involving the ex-

[1] In his Memoir read before the Academy of Paris in 1784, and reprinted by Pellier.

[2] 'Observ. Chirurg.' fasc. prim., Gottingæ, 1770.

ercise of hazardous pressure on the other; while by occupying the operator's second hand it deprives him of the advantage of himself commanding the upper lid. Its use is little likely to be revived at the present day.

The latter remark is applicable to several other contrivances, all having the same aim—to facilitate the section of the cornea; but which have respectively been employed coextensively only with their inventors' spheres of practice; or, if adopted for a time more widely, have now long fallen into oblivion. Thus, the father of Pellier de Quengsy tried to fix the eye, by providing the back of the knife with which he incised the cornea, with a notch or stop (like a half spear-point); but the idea was futile, as the instrument could not at the same time advance forwards to complete the section, and hold the cornea stationary by the backward pressure of the stop. Thus, Brambilla[1] published an engraving of a double speculum to act on both eyes simultaneously. It resembles two of Sharp's specula mounted at right angles on a connecting bar on which they slide. He describes its use as being "ad aperiandas palpebras, et firmandum si necesse fuerit oculum;" but judiciously adds "usus ejus fere exolevit. Præstat, rem potius digitis operantis et ministri peragi." Notwithstanding this remark, however, he gives the drawing of another speculum (fig. M) to aid extraction; writing, with reference to it, "hoc instrumento firmatur et reprimitur oculus, dum prædicti scalpelli apex oppositum corneæ latus subit." Thus Guerin, of Lyons,[2] devised the instrument represented in fig. N, intended to fix the eye by the pointed extremity of the forceps being implanted in the cornea on one side, while the knife-armed extremity made the requisite incision from the other. Thus, Pope of Troyes invented a kind of forceps resembling Assalini's, with one nib prolonged, flat, and sharp-pointed, to enter the margin of the cornea, which when pierced, the other nib should close upon, and hold secure, while the section was accomplished with a knife. It is figured by Pellier, but I have not thought it sufficiently plausible to reproduce. So I have shrunk from representing

[1] 'Instrumentarium Chirurg. Austriacum,' 1782.

[2] Author of 'Maladies des Yeux,' Lyons, 1769.

the intricate piece of mechanism known as the ophthalmotome of Guerin, of Bordeaux, who aspired to fix and achieve the section of the cornea by machinery, with what success the oblivion which has overtaken the once jealously guarded invention may show.[1] Contemporaries, however, disputed whether Guerin or Dumont were entitled to the credit of the suggestion, which by Sabatier[2] and Demours,[3] is divided between them. I despair of conveying an idea of Guerin's instrument; but the reader may form some conception of Dumont's, as engraved with modification by Demours (who extended its application to the removal of staphylomata), by imagining an implement resembling a common spectacle case, within which a knife is concealed. Towards its rounded extremity, this case is pierced with a circular aperture to receive (when applied flat to the surface of the eye) the cornea. That structure is then incised in the requisite direction by the knife working within the case and acted upon by a spring. The lids meanwhile are held apart by means of little wing-like appendages, attached to the upper and lower edge of the ophthalmotome, opposite its circular aperture. Perhaps I have already bestowed too many words on so thoroughly exploded a contrivance; but time was, that it was regarded with admiration as a veritable triumph of mechanical skill.

Pamart's lance (fig. A.), already alluded to, is as simple as the last-named instrument was complicated; and appears to have enjoyed considerable popularity on the continent, being still used there at the present day. It consists, as will be seen, of a simple, cylindrical stem, curved or nearly straight, according to the fancy of the surgeon, fixed in a handle, and terminating in a sharp point, with a projecting collar or stop close to it. The point was intended by the inventor to be inserted in the cornea, but the modern adopters of the instrument (as Desmarres, from the third volume of whose work,[4] fig. B, exhibiting the application of the instrument

[1] Its contriver declined to afford Pellier—when visiting Bordeaux, and anxious to pourtray in his work an engine which at that time excited considerable attention—an opportunity of examining it. Pellier notwithstanding gives detailed, but with difficulty intelligible, engravings of its several parts.

[2] 'Médecine Operatoire.'

[3] 'Traité des Maladies des Yeux.'

[4] 'Traité, Théorique et Pratique, des Maladies des Yeux,' Paris, 1858.

is copied) very properly substitute as equally advantageous and more safe, the sclerotic as the part to which it should be affixed. I can well believe that thus used it may impart a most desirable degree of steadiness to the eye, affording just sufficient counter-pressure to resist the thrust of the knife, tending to push the cornea towards the inner canthus. But it can hardly be equally efficient in accomplishing that which is at least equally desirable, viz., the control of the muscular movements of the globe. It would for the most part prevent motion in one direction only, and must be liable to be disengaged, so as suddenly to release the globe from control, if perchance the involuntary movement of the eye should take an outward direction. Moreover, the lance is obnoxious to another objection, the gravity of which experienced operators will acknowledge; that, by employing the second hand of the surgeon, it compels him to depend upon the assistant for the command of the upper, as well as the lower lid, and thus deprives him of the all-important power of himself regulating the exact degree and duration of pressure, or of ensuring its absence altogether. While, lastly, in relinquishing to an assistant the management of the upper lid, and still making the upper section, the operator must almost necessarily be in front, instead of at the head of his patient; and, in making the section of the cornea, cut away from instead of towards himself, a mode in which less accuracy is usually attainable. The "Pique de Pamart" may once more be employed here and there, as I am informed it has recently been at a London Eye Infirmary; but its utility is, in my opinion, so far outweighed by the inconveniences it involves, that modern British surgeons will never to any noticeable extent recur to it again.

In order to enable the surgeon to retain command of one lid while fixing the globe, and with the view of curtailing the number of fingers the lance involved the use of within a very limited circumference, a surgeon of Dresden designed the whimsical instrument (fig. c), which goes by his name as Rumpelt's thimble. This being worn on the operator's middle or ring finger of the non-operating hand, would, it was supposed, obviate some of the inconveniences of Pamart's pique; but it seems never to have been much

employed, and the practical surgeon will do well to regard only as a subject of history.

Yet Rumpelt's rude thimble probably suggested the idea of one at least of the neater appliances of Demours and Desmarres. The former[1] thus describes his "ophthalmostat"[1] delineated in fig. o, which he had first recommended in a memoir read at Paris in 1784: "Pour faciliter l'incision de la cornée j'ai imaginé un instrument composé de deux tiges de fer aplaties, qui embrassent le doigt, et qui sont terminées par une pointe recourbée." In the original memoir he enters much more into detail; directing the point of the ophthalmostat to be implanted in the cornea, the instrument itself being secured on the finger by the elasticity of its horse-shoe branches clasping the second and third phalanges laterally. In his larger work, published thirty-four years later, and containing a valuable series of plates, though commemorating his invention in the words just quoted, he gives no representation of the instrument in question. Perhaps it is not too much to infer from this omission that the mature and experienced surgeon had seen reason to relinquish the use of his once favorite appliance.

Desmarres' ring (fig. E) is a considerable improvement upon the contrivance last noticed, and (if we except the same author's singular suggestion of a lady's hair-pin[2]), is the latest attempt to supply by special mechanical means the desideratum which this long series of attempts has endeavoured to meet. It is composed of a circlet (to be worn on the extremity of the middle finger), from which rises a curved branch, terminating at a right angle in one or two fine points. At the part intended to correspond with the back of the finger, the ring, is spread out into two curved plates, which give greater firmness to the instrument; and, being ununited, permit of its adaptation to the exact size of the member. The branch springs from the part corresponding with the palmar aspect of the finger, along which it lies, so as in effect simply to arm the finger's end with the one or two fine points, in which it terminates. The design in short is, to furnish the

[1] Op. cit., vol. i, edit. 1818.

[2] "Les fortes et longues épingles que les femmes emploient pour fixer leurs chapeaux sur leur tête, ou pour attacher leurs châles, atteignent parfaitement le but."

middle finger, applied in the usual way on the globe at the inner canthus, with these points; and thus enable it, by their implantation, to command the globe more completely, and with less pressure, than when naked. I believe this contrivance to be the best which has hitherto emanated from the sedulous ingenuity of ophthalmic surgeons. It is simple, probably effectual, and it necessitates not a single change in the mode of procedure generally recognised as the best. Yet I cannot but entertain objections to the puncture of the sclerotic (and perhaps deeper textures) which it inflicts; and can readily foresee possible risk to the cornea in attempting to affix the points satisfactorily in a restless eye, with other unpleasant contingences in detaching them instantaneously on the completion of the flap. On the whole, admitting the merits of the instrument to be greater, and its drawbacks less, than those of any of its predecessors, I should be loth to use it myself, and should regret its introduction for habitual employment in this country.

The retrospective part of my subject is now finished. In the preceding pages I have reviewed all the principal contributions to the armoury of the profession having the object in view with which we are engaged. Some of less note it is likely may have escaped my research; but we may fairly argue, if those which in their day achieved celebrity are found so little entitled to our praise now, we have small reason to regret the obscurity from which others, if such there be, have never emerged. In conclusion, there is little difficulty in subscribing to Guthrie's summary declaration—"The specula of Beranger, &c., as well as those of more modern invention, are all abandoned as worse than useless."[1]

The defects of particular instruments, and the constant failure of repeated endeavours to produce others less open to animadversion, justify the sweeping condemnation just quoted, endorsed as it is by the nearly unanimous voice of the best British authorities in ophthalmic surgery. But that condemnation has reference to past abortive efforts, and cannot prejudice fresh suggestions. For observe, in spite of this and similar expressions of opinion, the practical fact remains,—that

[1] 'Operative Surgery of the Eye,' 1827, p. 230 *note*

a good position of the cornea, and steady condition of the globe, greatly favour the accomplishment of an adequate section, and the preservation of the iris from injury; that these auspicious preliminary circumstances are in many cases quite unattainable by the unaided fingers of the operator and his assistant; that casualties occurring to competent surgeons at this stage of the proceeding (which influences all the subsequent steps) are mainly attributable to this deficiency of control; and that if such deficiency could be remedied by art, without some countervailing evil attending the means employed, an immense advantage would accrue.

Even Guthrie, whose sentence I have cited and concur in, virtually admits this to the full, by proceeding at once to try his own hand at a device to incise the cornea while protecting the iris, the real aim of all the specula he censures; but he succeeded no better than his predecessors in persuading the profession at large to adopt his views. It remains for me, with humbler pen, to show how the desired advantage may be gained by simpler means.

For many years I have been accustomed to steady the eye during extraction by the contact and pressure of the fingers alone, according to the practice of most modern operators; the forefinger holding the upper lid, and restraining the globe's movement upwards, the middle finger on the caruncle curbing its movement inwards. In many cases this arrangement is sufficient for the purpose, and the section is made not only satisfactorily but with ease. In how great a degree, however, that ease is dependent on the patient's strength of nerve and steadiness of eye; and how limited the surgeon's real command of the globe is apt to prove, when the opposite qualities are manifested (especially if the anatomical conformation of the parts happens at the same time to be unfavorable), every operator of wide experience and equal candour must confess. Can no unobjectionable means then be devised which shall render his command absolute?

In operating for the formation of artificial pupil I first became aware of the practicability of holding the eye perfectly still and motionless, or as nearly so as possible, by the mere application of artery forceps. The idea at length was suggested of extending the use of this instrument to another

operation, in which, as far as I know, it had never been employed, (at least in this country,) before; of availing myself, in short, of the same resource as in cases of artificial pupil (and with a similar object) in cases of extraction.

I have since brought the idea to the test of experience, with the result which it is my present object to make known,—the result, that is, of facilitating in a degree I could not have anticipated, the most critical stage of this operation. The mode in which I proceed is as follows. As soon as the patient is laid on the operating table and all the preparations are complete, standing at his head, I apply the extremity of the forceps with rather firm pressure a little beneath the inferior margin of the cornea, and clasp a somewhat broad portion of conjunctiva and of the submucous fascia securely. Then, taking the instrument between the finger and thumb of the other hand, as near as practicable to its closed points, I deliver it to the assistant; whose hand, supported upon the patient's cheek, receives it, and holds it as he would a pen. It is well that the assistant should be practised in his share of duty on the dead subject. The ordinary artery forceps are, on the whole, preferable to those with a spring catch, commonly known as Liston's; but it is of consequence that the nibs should be broad, and the teeth sufficiently prominent. The lower lid requires no further depression than that necessarily produced by the attachment of the instrument to the ball in this way. I then raise the upper lid with the fore-finger, direct the assistant to draw the cornea into a central position and retain it there with the forceps, place my fore and middle fingers on the globe in the usual way, and thus perfect the command of the organ. On now making the section, the eye is found steady and motionless; the knife can be deliberately entered, deliberately carried across the chamber, and deliberately brought out on the inner side of the cornea; and counter punctuation being fully effected, and the flap on the verge of completion, the object of the forceps is accomplished, and they are at once disengaged. The remainder of the operation is finished in the ordinary manner.

I have had much experience in the operation of extraction, having performed it myself considerably upwards of a hundred times; and of course am familiar with its pleasures (so to

speak), and its difficulties, its contingent casualties, and the sequelæ of embarrassment attending them. After one or two trials, therefore, I was in a position to estimate the amount of advantage gained by the accessory manipulation just described; and this has proved indisputably so great, that I have employed the forceps without exception ever since. It will, perhaps, be the best way to place before the reader the facts which the current season has enabled me to gather, as practical criteria of the soundness of my conclusions.

I have, then, since conceiving the idea that forceps would be beneficially available in this operation, performed extraction in the following cases: the recumbent posture; the superior section; generally the previous application of atropine; Beer's knife; and the use of the right or left hand respectively, as the cataract was to be removed from the right or left eye, being adopted in all; several of the patients had cataract in both eyes, but that operated on alone is indicated.

Case i.—May 5th. Mary G—, æt. 54; healthy; left eye. Applied forceps at the outset, but they became disengaged, and I then contented myself with commanding the globe in the ordinary way; operation completed without casualty. Good vision restored, to read, &c.

Case ii.—May 5th. Mary W—, æt. 68, very infirm, of Deptford; arcus present; left globe held with forceps, which proved of essential service in keeping quite steady the eye of a nervous woman; section made and cataract extracted satisfactorily; but wrinkled the cornea immediately became sunken, concave, and (though no vitreous humour had escaped), evidently from abnormal thinness and impaired elasticity. On examining the eye again in half an hour, I found the cornea resuming its natural shape. The case progressed without a subsequent bad symptom, and excellent vision was recovered.

Case iii.—May 19th. Ann B—, feeble and half-starved, æt. 54; eyes small; amaurosis of left, with clear pupil; cataract of right; the globe held by forceps; good flap. All proceeded well at the operation, but chronic ophthalmia with much intolerance and neuralgia retarded the cure. On July 16, however, she was presented with the eye free from inflammation and with excellent vision.

Case iv.—May 19th. Robert J—, æt. 55, a gardener, from Wickham Market, healthy. Right globe held with forceps, which were of much use as the patient lost his self-command; good flap; pupil contracted, circular, and central at conclusion of the operation. A prolapse of iris afterwards arose; but this yielded to puncture, followed by caustic and an opiate collyrium accompanied by nutritious diet. July 26th, the patient was presented, seeing well with the operated eye.

Case v.—May 19th. Miss Mary K—, æt. 66, of very sallow complexion and impaired constitutional power, residing at Winchelsea. Left globe held with forceps; flap being somewhat limited on nasal side, I enlarged it with bistoury, and then extracted with ease a firm nuclear cataract invested in an abundance of softer cortex. Some remains of the latter for a week or two lingered in the pupil; but excellent vision was restored by the 5th of July.

Case vi.—May 17th. Miss B—, æt. about 65, residing temporarily in Mornington Crescent; healthy but nervous. Right eye, restless and unsteady from mental agitation, would probably have occasioned much trouble, but for the aid of the forceps. With this assistance a good flap was at once formed. The instrument was affixed where a vein happened to emerge; and a thrombus beneath the conjunctiva was the immediate result. Everything notwithstanding proceeded well, the thrombus had disappeared when the eye was opened; and on June 10th the lady returned into the country with excellent vision.

Case vii.—June 9th. Stephen C—, æt. 56, from Wickham Bishops, Essex, baker. Eyes prominent, and the right previously subjected to keratonyxis, which had left the capsule open. Right globe held steady by forceps in spite of patient's nervousness, which was so great, that after accomplishing counter-punctuation satisfactorily, at the moment of completing the section he suddenly raised his head from the pillow. A gush of vitreous humour, carrying the cataract with it, instantly ensued; and the globe became comparatively sunken, the cornea concave, and the wound gaping. To flatten down the edge of the flap and close the wound by means of gentle friction through the lid, and then to promote contraction of the pupil by exposure to light, were the measures adopted prior to closing the lids with plaster, and placing the man with his head well elevated in a chair.

He had little pain or uneasiness; six hours after the operation, the globe had resumed its bulk, the cornea its form, and the flap (as far as could be ascertained) its normal position. Considerable inflammation arose in the course of the next ten days; but this gradually subsided; and the man recovered a sound eye and good vision, notwithstanding the enlargement and partial displacement of pupil, which always result when a portion of the vitreous has been lost.

Case viii.—June 9th. John B—, æt. 74, of Greenwich, formerly a pilot, apparently a hale man, but with indications of serious heart-disease. On the table he became nervous and fidgety; but forceps contributed materially to steady the right eye, and an adequate section was effected satisfactorily. A portion of cortex remaining in the anterior chamber after the extraction of the main body of the cataract was removed by fresh gentle pressure. He progressed favorably for the first nine days, when projection of the flap, swelling of the lids, and pain in the eye, supervened. From this time considerable inflammation with photophobia set in, maintained by a prolapse of the iris. The latter was punctured, and nitrate of silver applied with benefit, but his convalescence was tedious and not complete at the time of writing, Aug 24th.

Case ix.—June 3d. Mr. B—, of Wandsworth Road, æt. 69, anæmiated and much out of health, on which account I had deferred operation from October, 1857. Right eye amblyopic; both pupils indolent; and general appearance unpromising. Left globe was well fixed by forceps, the section accomplished satisfactorily; and after removal of the cataract, though the cornea became concave, the pupil looked clear, central, and moderately contracted. No bad symptom followed; and the eye recovered with a clear, bright pupil, and fair vision, but not sufficient to read,—a better result than I had ventured to reckon upon.

Case x.—June 23d. Susan A—, æt. 71, tall, thin, and weakly in the extreme, knuckles deformed by attacks of rheumatic gout; arcus. Right eye held by forceps, ample section made, and capsule opened freely; but cataract slow in emerging, owing to its enormous size and density. A little vitreous followed its passage; but the pupil appeared central, and the flap in good position before plaster was applied. No bad

symptoms arose, and, on July 21, she was presented, with excellent vision.

Case xi.—June 23d. John M—, æt. 65, from the hospital estate at Long Sutton, Lincolnshire, a healthy man, from whom I had extracted the right cataract last year. The difficulties of the operation were then great, from the unsteadiness of the eye, which necessitated the completion of the section by the bistoury. He, however, recovered good sight, which is still preserved. Left eye held by forceps, which proved most valuable in fixing the globe, and so preventing a recurrence of the difficulties of last year. Section made at once, and cataract extracted satisfactorily. July 21st. Convalescent, good vision restored, though a little film of capsule lingers behind the lower part of the pupil.

Case xii.—June 23d. Elizabeth F—, æt. 62, of Oxford, also had the right cataract extracted by me last year; and retains excellent sight—to read and to work, &c. Left eye now held steady by forceps; section, opening of capsule, and removal of cataract accomplished without casualty. For the first four days she did well; then atonic inflammation set in, with serous chemosis, extensive infiltration of cornea, hypopyon, and subsequently reopening of the wound. Under active measures of stimulus and support, the threatened suppuration was averted, the cornea cleared up, and the flap reunited. But an artificial pupil must be formed before useful vision can be regained.

Case xiii.—July 21st.—Margaret G—, æt. 54, healthy. Left iris adherent extensively to capsule, right free: right eye held by forceps, flap ample, no injury to iris or vitreous escape; arthritic inflammation and prolapse of iris, however, supervened, but were subdued, and the patient convalesced with useful vision.

Case xiv.—July 21st. Sarah G—, æt. 63, of Camberwell. Left eye held by forceps, flap being insufficient required to be extended with bistoury. The usual difficulty was encountered in doing this, and the edge of the pupil was caught on the blunt extremity of the bistoury in withdrawing that instrument, but no perceptible wound was inflicted. Recovery was rather slow; but good vision was re-established by August 28.

Case xv.—July 21st. Robert M—, æt. 80, shoemaker, formerly a soldier, and present with Nelson at Copenhagen and

the battle of the Nile. Left eye held by forceps, good flap, large and dense cataract extracted satisfactorily. No unfavourable symptom arose locally; but he was attacked with acute bronchitis from previous exposure under a tent; and died on the 24th, rather suddenly. The heart was found excessively fatty; an arcus had been noticed during life as only "slight."

Case xvi.—July 21st. John C—, æt. 65, a man of weak intellect, had the right cataract extracted by me in 1856. The difficulty of the operation was extreme, from his inability to keep the eye still; but he obtained, and still enjoys, good sight with that eye. Left eye held by forceps, which entirely obviated the inconveniences experienced on the former occasion; good flap; cataract emerged on the instant of its completion accompanied with a little vitreous, but not enough to affect the volume of the globe. He did well; and recovered a clear pupil and excellent vision.

Case xvii.—August 4th. James P—, æt. 55, had undergone keratonyxis twice, and so obtained absorption of the fluid portion of a left cataract, which was still bulky enough to occupy the whole pupil. Last year he was twice put on the table for the purpose of extraction; but the spasms of the orbicularis, and incessant movement of the eye, combined with natural prominence of brow, made the performance of the operation so extremely hazardous that I abandoned the attempt. In short, though an old sailor, he utterly lost his self-command. This day he was again placed on the table, when the contractions of the orbicularis and recti set in as before; but the forceps enabled me to overcome the difficulty, and keep the eye sufficiently steady, and in fair position. An adequate section was made; and, as anticipated (the capsule being already open), the cataract passed forth at once. August 28. Convalescent, with a clear, black pupil; but vision imperfect from amblyopia.

Case xviii.—August 4th. Thomas S—, æt. 56, a farrier, from Hampstead. Right eye held by forceps in good position; much spasm of orbicularis; on completing section, the capsule yielded spontaneously, and the cataract, accompanied by some vitreous, was immediately expelled; pupil left clear, and flap and iris *in situ* before applying plaster. August 28. Convalescent, with good vision.

Case xix.—August 11. Mrs. K—, æt 53, for whom I had extracted the left cataract in private four years ago. The right eye was held quite steady, and the cornea central, with forceps. The section required enlargement with the bistoury, which was effected without injuring the iris, after which the cataract emerged satisfactorily. August 28. Considerable conjunctivitis remaining; but flap healed; pupil clear, and good vision regained.

Case xx.—August 9. Mrs. W—, æt. 54, residing in Hampshire, but staying for the operation with her daughter in Walworth; a stout hale person, with an enormous bronchocele. The left globe was kept quite still with the forceps; and the operation, otherwise conducted in the usual way, was completed exactly as desired. She progressed without an unfavorable symptom, and was convalescent on August 28, with every promise of excellent vision, the pupil being central and circular, though temporarily clouded with a portion of soft cortex.

The above examples comprise all the cases of extraction I have operated on during the present season, since adopting the use of the forceps; and the effect of the instrument has unquestionably been in an eminent degree advantageous. It has facilitated the operation in difficult cases, in exact proportion to their previous difficulty and risk. This was strikingly evinced in Cases 11 and 16; both of which patients had, at a former period, occasioned the utmost anxiety, from the impediments their restless eyes presented to the satisfactory performance of the operation. They, indeed, recovered their sight well, but it was in spite of dangerous obstacles. This year they each recovered the sight of the second eye, under circumstances strongly contrasted; that which was so embarrassing before was now effectually surmounted at the very outset, by the simple means we are considering. Still more remarkable in some respects is Case 17, that of the sailor; who on two previous occasions had proved so utterly uncontrollable, that I was compelled to desist from the attempt to operate. On the present occasion, with the aid of forceps, after a little preliminary trouble, the globe was brought into and held in a sufficiently favorable position for a good section

to be made. Could more convincing evidence be afforded of the value of this appliance?

The assistance rendered by the forceps is further illustrated by the fact, that in not a single case did premature escape of the aqueous humour (with its attendant inconvenience of the iris folding over the knife, and forbidding the immediate completion of the section on pain of wounding that membrane) occur. In three cases only did the first incision prove from any cause inadequate, and resort to the bistoury become expedient; and it was in one of these alone (in manipulating the bistoury after the forceps were detached) that the iris was sensibly touched.

I am well convinced that the advantages of the mode of operating now recommended will be fully appreciated upon trial: it may, therefore, be better for me to bestow a word or two in anticipation of any objection which might perhaps deter some one from the experiment. Really, the single objection which occurs to me as sufficiently plausible to merit notice (if the directions above given be followed, and especially that of disengaging the forceps as soon as counter-puncturation is complete, and before cutting out), is, that the conjunctiva might possibly suffer injury from the forceps sufficient to awaken troublesome inflammation, and compromise the result. A conclusive answer is afforded by experience: no mischief has, in any case, under my observation, ensued; and this fact is substantiated, not by the foregoing cases alone, but also by numberless cases of artificial pupil, in which forceps are now habitually used, as well as by many others of soft cataract (to which I have latterly extended their use), and which are all equally available for the determination of this point.

It is right that I should ackowledge myself indebted to the work of Desmarres, already referred to, for the *idea* of adapting artery forceps as an "ophthalmostat" in extraction, but not for their *advocacy*. He, in fact, discountenances their use, giving a preference it is needless here to impugn, to Pamart's lance, and his own peculiar thimble. He appears to have employed the forceps (if at all, which is doubtful) with his own hand, instead of confiding them, as I have done, to

another; and thus to have encumbered their application with a serious drawback. For he must, of necessity, in consequence, have committed charge of both lids to the assistant;[1] and so relinquished the twofold advantage of commanding the upper lid himself, and of aiding, with his fingers in the usual position at the lid and canthus, the influence of the forceps and the guidance of the knife.

His observations, however, upon the general question of fixing the globe by some artificial means, are so much to the purpose, that I cannot forbear transcribing them in this place, as an able vindication of the practice, and an appropriate conclusion to the present paper. He writes:[2] "Tout chirurgien véritablement prudent n'exécutera pas l'operation de la cataracte par extraction, sans préalablement avoir fixé l'œil . . . . . Ainsi, tel malade parfaitement résigné quelques moments avant de se livrer au chirurgien, perd tout à coup contenance; ses yeux, excités par le contact du couteau et du doigt, s'agitent violemment, tournent dans l'orbite; l'orbiculaire se contracte en même temps, et une pression considérable, augmentée encore de celle nécessitée par l'écartement des paupières, pèse sur la cornée qui, tout à l'heure, sera ouverte. Chez tel autre patient l'œil fuit dans le grand angle, poussé par le kératotome, et c'est au hasard qu'il faut faire la contre-ponction de la cornée dont le bord interne, malgré la pression du doigt médius de l'opérateur, va se cacher derrière la membrane semi-lunaire et la caroncule lacrymale. J'admets, qu'avec de l'habitude on puisse dix-neuf fois sur vingt, peut-être, opérer avec succès sans fixer l'œil; mais on m'accordera que si, une fois sur vingt, on laisse volontairement au hasard quelque éventualité malheureuse, on regrettera amèrement un accident qu'on aurait pu éviter. L'œil doit donc, dans l'extraction, être absolument fixé, parce qu'en chirurgie on ne doit jamais rien abandonner volontairement au hazard."

[1] This is evident from the words, "La pique de Pamard, a comme d'autres instruments nécessaires à la fixation de l'œil, le désadvantage d'obliger l'aide à écarter les deux paupières" (vol. iii, p. 184); and is further demonstrated by the figure at page 200.

[2] Vol. iii, p. 183.

Plate I and II,

Showing the instruments referred to in Mr. France's paper on Extraction of Cataract.

A. Pamart's lance.

B. Mode of using Pamart's lance, as modified by Desmarres; all the fingers are those of assistant, the operator's hands being occupied by the two instruments.

C. Rumpelt's thimble.

D. Sharp's speculum.

E. Desmarres' ring-thimble, worn on operator's middle finger.

F. Ancient common speculum oculi, of reduced size, after Dionis.

G. Miller's or Else's speculum, the flat ring to be pressed on the sclerotic, the projecting curved plate to receive and support the lid.

H. Pellier, sen.'s, speculum.

I. (A and B.) Adams's speculum, in two views.

K. Beranger's double hook.

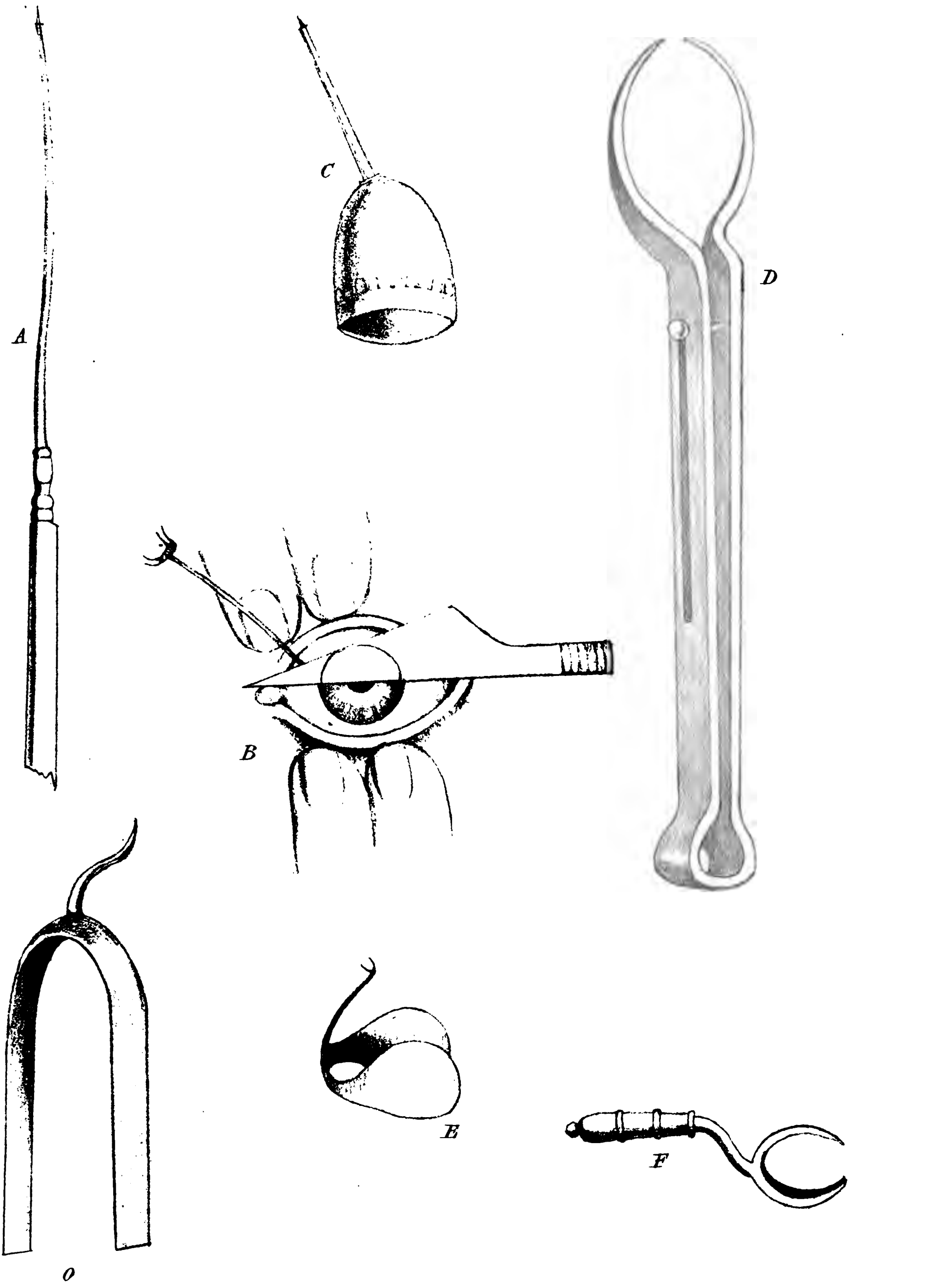
L. Pellier, junr's., crescent.

M. Single branch speculum, after Brambilla.

N. Compound instrument for fixing and incising cornea, of Guérin, of Lyons.

O. Desmours' yoke-thimble, the branches to clasp the finger's end, the point to be implanted in the cornea.

Plate I.



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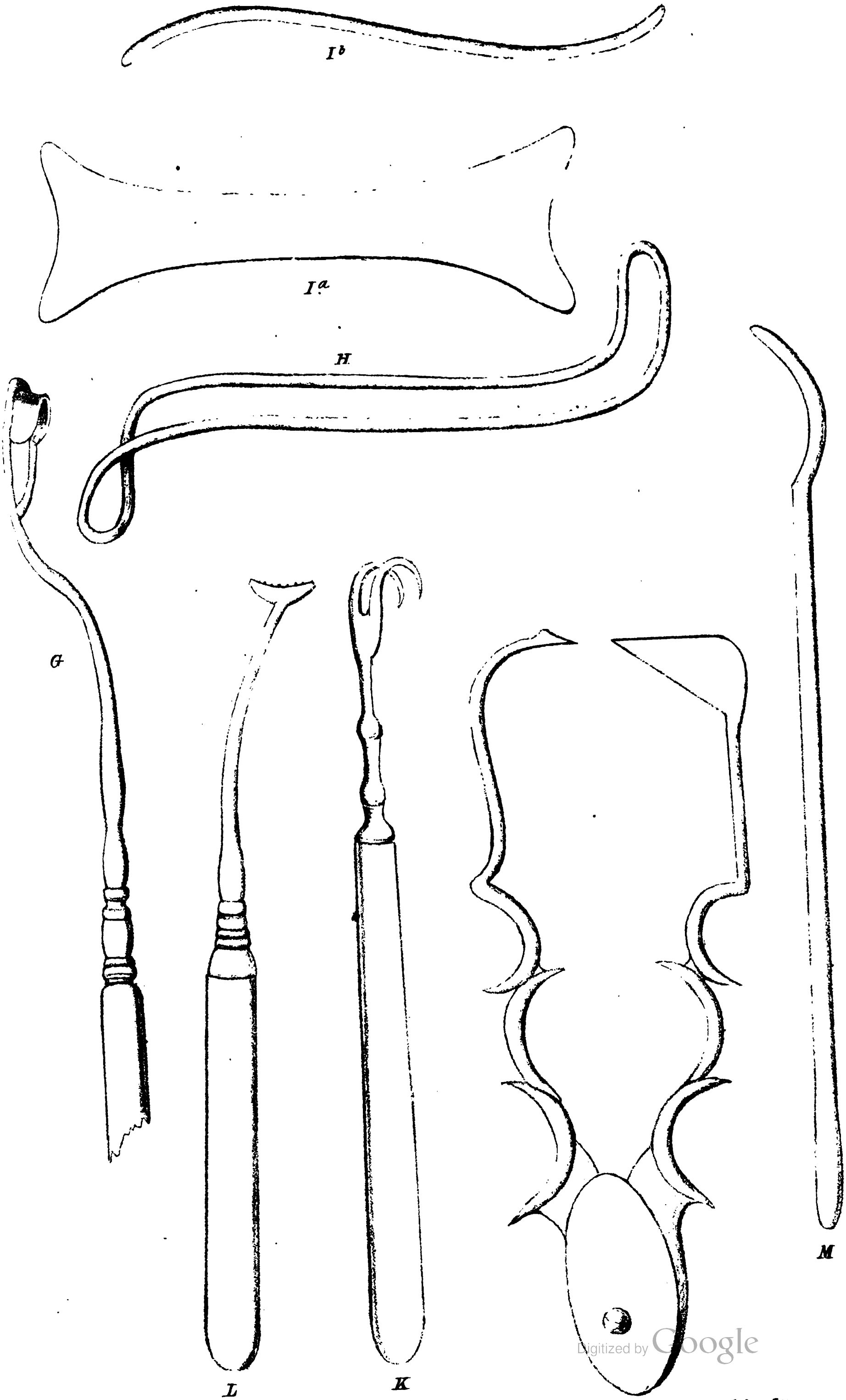
Day & Son. Lithrs to The Q

Plate II.



Day & Son, Lith

ON THE

EXISTENCE OF COPPER

IN

ORGANIC TISSUES.

BY WILLIAM ODLING, M.B., F.C.S.,

AND

AUGUST DUPRÉ, Ph.D.

WHETHER or not copper is a normal constituent of organic structures is a question of much interest, and one that has received the attentive consideration of several distinguished toxicological and physiological chemists. It has been affirmed by some experimentalists that whenever copper occurs in animal or vegetable tissues or fluids, its presence is to be looked upon as exceptional, or abnormal, or accidental; while others equally eminent have maintained that copper is a natural and constituent of living organisms. Our own experiments are in favour of the latter view, and at any rate demonstrate the very extensive distribution of copper in the organic kingdom.

Our attention was accidentally directed to the subject of normal copper in the latter part of the year 1856, during the performance of a series of experiments upon the composition of bread. In one specimen of bread an unlooked-for manifestation of copper obtruded itself on our notice, and in several other samples we were able to recognise the presence of the metal. Subsequently we have made deliberate search for the

existence of copper in bread, flour, wheat, straw, liver, kidney, blood, flesh, eggs, cheese, &c. Our results have a certain value of precision, inasmuch as we can generally state the exact amount of substance upon which we operated, and we believe that in some cases we have been able to identify the presence of copper in smaller quantities of material than have been employed in previously recorded experiments. Moreover, in several instances we have determined the copper quantitatively.

Bread.—In the fourth of a series of twenty-five samples of bread that came under our notice, the presence of copper attracted our attention in the following manner. 194·1 grains of dried bread were burnt to a white ash, which was dissolved in a little hydrochloric acid, and the solution super-saturated with ammonia. On the separation of the resulting precipitate by filtration, the ammoniacal filtrate was observed to have a decided blue colour. A suspicion of cupric contamination was at once excited, and the existence of copper confirmed by acidifying with hydrochloric acid and adding ferrocyanide of potassium, whereby the chocolate-coloured precipitate of ferrocyanide of copper was produced. Another portion of the same bread was then incinerated, the ash dissolved in hydrochloric acid, the solution transferred to a small platinum capsule, and a piece of zinc introduced so as to touch the platinum through the liquid. By the electrolytic action thus set up, a characteristic deposit of metallic copper took place on the platinum. The contents of the capsule were poured off, the capsule well washed, and the deposit treated with ammonia, in which it gradually dissolved, forming a deep-blue coloured liquid. This, after neutralization with hydrochloric acid, gave the usual chocolate-red precipitate with ferrocyanide of potassium. In consequence of this result the other twenty-four samples of bread were specially tested for copper. As in each case one and the same portion of ash had to serve for the detection of alumina as well as copper, it was first dissolved in hydrochloric acid and super-saturated with potash. Then, the washed precipitate was dissolved in hydrochloric acid, and this solution treated by the electrolytic process above described. By these means, in six other specimens of bread, the presence of copper was rendered evident, but in

no instance to such an extent as in the one specimen specially referred to, in which we first recognised the existence of the metal. The results of this series of experiments are embraced in the following table:

Number of the specimen.	Grains of dried bread used.	Per centage of ash in dried bread.	Grains of ash obtained.	Copper.
IV	194·1	2·19	4·27	much.
VI	163·2	2·47	4·05	—
X	196·3	2·20	4·32	—
XVI	237·3	2·39	5·67	trace.
XX	219·6	2·90	6·38	trace.
XXI	168·4	2·26	3·80	trace.
XXIV	166·2	2·56	3·97	—

From the seven bakers whose bread had yielded us copper, other loaves were subsequently obtained, and in each instance the presence of the metal again recognised. The specimens, Nos. XX, XXI, and XXIV, were full-priced loaves procured at most respectable shops, and did not contain alum. We have subsequently examined fifteen other samples of bread, and in these cases have employed quantities of material four or five times greater than those used in our first series of experiments. The results are as follows:

Number of the specimen.	Grains of dried bread used.	Per centage of ash in dried bread.	Grains of ash obtained.	Copper.
I	1000·0	2·39	23·9	—
II	1000·0	2·63	26·3	—
III	1000·0	2·57	25·7	—
IV	1000·0	2·39	23·9	—
V	1000·0	2·32	23·2	—
VI	1000·0	1·92	19·2	trace.
VII	1000·0	1·91	19·1	—
VIII	1000·0	2·55	25·5	none.
IX	1000·0	2·54	25·4	—
X	1000·0	1·97	19·7	—
XI	1000·0	1·04	10·4	—
XII	1000·0	1·73	17·3	—
XIII	1000·0	2·02	20·2	—
XIV	778·3	2·19	17·1	—
XV	588·6	2·19	12·9	—

The specimens, Nos. X and XIII, did not contain alum.

The circumstance of our finding copper more uniformly in the second series of experiments than in the first, arises, we believe, solely from the fact of our having employed larger quantities of material.

Flour.—We have examined twenty samples of wheat flour by precisely the same process as that used in the case of bread—that is, by dissolving the ash in hydrochloric acid, precipitating with potash, dissolving the precipitate in hydrochloric acid, electrolyzing the resultant solution with zinc and platinum, and corroborating with ammonia and ferrocyanide of potassium. The results are embodied in the following table:

Number of the specimen.	Grains of dried flour used.	Per centage of ash in dried flour.	Grains of ash obtained.	Copper.
I	872·9	0·47	4·13	—
II	663·6	0·75	5·03	—
III	774·5	0·76	5·91	much.
IV	687·6	0·81	5·63	—
V	635·5	0·76	4·83	trace.
VI	688·6	0·84	5·79	—
VII	675·0	1·32	8·91	—
VIII	588·6	0 90	5·35	trace.
IX	675·0	0·82	5·42	trace.
X	588·6	0·96	5·65	—
XI	575·0	0·87	5·04	—
XII	588·6	0·84	4·98	—
XIII	461·9	0·95	4·40	—
XIV	362·3	0·85	2·92	—
XV	572·3	0·90	5·18	—
XVI	574·5	0·77	4·47	—
XVII	589·0	1·12	6·63	trace.
XVIII	600·4	0·83	5·00	—
XIX	593·2	0·86	5·14	trace.
XX	594·3	0·73	4·33	—

In every specimen we succeeded in detecting the presence of the metal. In five cases we met with mere traces, while in one case the amount was considerable.

Grain.—We have examined 29 specimens of grain, or rather of the ash of grain. For the greater number of our samples of ash we are indebted to the kindness of Messrs. Lawes and Gilbert. The specimen of Indian corn ash was kindly furnished us by Dr. Forbes Watson. Our results are embodied in the following table:

	Description and number of specimen.		Year of growth.	Amount of fresh substance in grains.	Per centage of ash in fresh substance.	Per centage of ash in dried substance.	Grains of ash employed.	Amount of oxide of copper in grains.	Reagent or process.
Wheat.	I	R.E. Unmanured	1851	1513·3	1·65	1·96	25·0	much.	Ferrocyanide of Potassium.
	II	" "	1852	1432·6	1·74	2·11	25·0	—	"
	III	" "	1853	1227·2	2·03	2·54	25·0	—	"
	IV	" "	1854	1489·9	1·67	1·97	25·0	little.	"
	V	" "	1855	1398·9	1·78	2·10	25·0	little.	"
	VI	" "	1856	1468·8	1·70	2·07	25·0	much.	"
	VII	" Farm-yard manure	1851	1513·3	1·65	1·95	25·0	much.	"
	VIII	" "	1852	1492·5	1·67	2·01	25·0	little.	"
	IX	" "	1853	1379·9	1·81	2·25	25·0	—	"
	X	" "	1854	1439·2	1·73	2·02	25·0	little.	"
	XI	" "	1855	1412·4	1·77	2·11	25·0	little.	"
	XII	" "	1856	1509·3	1·65	2·00	25·0	—	"
	XIII	" Mineral and ammoniacal	1851	3156·5	1·58	1·87	50·0	0·008	Electrolysis.
	XIV	" "	1852	2977·9	1·67	2·00	50·0	0·009	"
	XV	" "	1853	2898·5	1·72	2·13	50·0	0·008	"
	XVI	" "	1854	3059·9	1·63	1·90	50·0	0·008	"
	XVII	" "	1855	2880·1	1·73	2·05	50·0	0·012	"
	XVIII	" "	1856	3123·0	1·60	1·92	50·0	0·008	"
	XIX	Red Rostock. Unmanured ...	...	6024·1	1·66	...	100·0	0·023	"
	XX	Silesian	...	4375·0	1·57	...	67·4	0·012	"
	XXI	Specks	...	3937·5	1·48	...	59·6	0·009	Electrolysis + Ignition.
	XXII	Saxonka	..	3062·5	1·82	...	56·3	0·006	Electrolysis + Sarzeau.
	XXIII	American	...	3062·5	1·67	...	49·3	0·005	Electrolysis + Sarzeau.
	XXIV	Polish Odessa	. .	800·0	1·55	...	12·4	—	Ferrocyanide of Potassium.
Barley.	I	R E. Unmanured	1854	2378·6	2·06	2·52	50·0	0·005	Electrolysis + Ignition.
	II	" Farm-yard manure	1854	2369·6	2·11	2·57	50·0	0·007	Electrolysis.
	III	" Mineral and ammoniacal	1854	2442·1	2·04	2·51	50·0	0·008	"
Maize.	I	... ...	...	4000·0	1·30	...	52·1	0·025	Electrolysis.

The initials R.E. stand for the Rothamstead experimental crops grown by Mr. Lawes. Each of the strips of land devoted to these crops has been treated continuously in one specific manner for many successive years. Thus, the first six of the samples we examined had been grown on one and the same strip of land that had not received any manure whatever. The second six samples had been grown on a similar strip that had received annually a dressing of farm-yard manure, &c., &c. In the first twelve and the twenty-fourth samples of wheat ash, the copper was detected in the following manner: The ash was treated in a capsule with nitro-muriatic acid, and the liquid, after evaporation almost to dryness, was diluted with water, super-saturated with ammonia, and filtered. One or two drops of ferrocyanide of potassium were added to the ammoniacal filtrate, which was then slightly acidulated with acetic acid, whereby an abundant pinkish-white precipitate was produced, which, on subsidence, presented in every case a decided reddish-pink colour; that is to say, that, in every case, there was sufficient cupric ferrocyanide produced to colour the great mass of what would otherwise have been a white precipitate.

This process was originally recommended by Sarzeau in 1830, partly as a means for detecting copper in vegetable ashes, partly as a means for obtaining the copper in small bulk prior to its estimation. As a rapid and delicate mode of detecting copper, we can speak of it in very high terms. As a preparative for the estimation of copper we have not found it necessary, though in some cases it may possibly prove advantageous. In our common-place book we jotted down, from the appearances of the precipitates, our impressions as to the amount of copper present. We have transferred these notes "much" and "little" to our table, but are not disposed to attach any importance to them.

In the samples of wheat numbered from XIII to XX inclusive, in the samples of barley, Nos. I and II, and in the sample of Indian corn, we made estimations of the copper by the following process: The ash was treated with hydrochloric acid, containing a little nitric acid, and the whole evaporated to dryness. To the residue water was added, and a few drops of hydrochloric acid. This liquid was super-saturated with ammonia and filtered. The

filtrate was evaporated to a small bulk, acidulated with hydrochloric acid, and introduced into a decomposing cell of the description shown in the accompanying woodcut. The inner cylinder consists of a piece of glass tubing, about half an inch in diameter, and six inches in length, open at the top, and closed at the bottom with a piece of thin bladder. This tube contains the cupric solution. The exterior cylinder is filled with water acidulated with hydrochloric acid. From the silver plate of one of Smee's single-cell batteries, or from the copper plate of one of Daniell's, there passes an iron wire, P, into the exterior cylinder; and from the zinc plate of either battery there passes a platinum wire, N, into the interior cylinder. This last, of course, constitutes a negative pole of the battery, and upon it the copper is gradually deposited. The battery is allowed to continue in feeble action for twenty-four or thirty-six hours, by which time the wire has generally received a coating of metallic copper, ordinarily red, uniform, and adhesive, sometimes black and pulverulent. The

platinum wire is then detached, the deposit well washed with water, and finally treated with nitric acid diluted with an equal bulk of water. The nitric acid dissolves off the copper, forming a solution of nitrate of copper, which is collected in a small platinum capsule, evaporated to dryness, ignited, and the resultant black oxide of copper weighed. We have found this process extremely well suited for the estimation of minute quantities of copper. We believe that by its use the copper is not likely to be over-estimated, though, in some cases, it may be under-estimated from the incomplete precipitation of the metal. The black oxide of copper finally produced was always a very visible quantity. It was dis-

solved in hydrochloric acid, and tested with ammonia and with ferrocyanide of potassium. The samples of wheat ash Nos. XXII and XXIII were precipitated with ferrocyanide of potassium, as previously described. The ferrocyanide precipitate was collected, dried, ignited, and dissolved in hydrochloric acid, with a drop or two of nitric. This solution was evaporated nearly to dryness, diluted with water, rendered ammoniacal, filtered, acidulated, and submitted to electrolysis. We did not, however, recognise any particular advantage from the adoption of this more complex method. In the specimens of wheat No. XXI, and of barley No. I, we introduced another modification. After treating the ash with hydrochloric and nitric acids, evaporating to dryness, treating with acidulated water, and super-saturating with ammonia, we evaporated the ammoniacal filtrate to dryness, ignited it to drive off the ammoniacal salts, dissolved the residue in hydrochloric acid, diluted with water, and submitted the liquid to electrolysis. By driving off the ammoniacal salts, we were able to obtain our final cupric solution in very small bulk, prior to its being submitted to electrolysis; but this advantage scarcely compensated for the increased trouble attending the process.

Other vegetable substances.—We have examined seventeen other samples of the ash of vegetable products, for the whole of which we are indebted to the kindness of Messrs. Lawes and Gilbert. Our results are represented in the accompanying table. For the most part we made use of the processes described above in reference to the preceding table. In the specimens of wheat straw, Nos. III, IV, V, and VI, and in the specimens of barley straw, Nos. I and II, we prepared our solutions as for electrolysis—that is, by treating the ash with nitro-hydrochloric acid, evaporating down, diluting, supersaturating with ammonia, filtering, evaporating to dryness, and acidifying. We then immersed in each solution a steel needle, which in every case became thoroughly coated with copper in less than twenty-four hours. For the simple detection of copper, in cases where time is no object, we consider this old steel-needle process as satisfactory as any hitherto proposed. It is certainly more delicate than the zinc and platinum process previously described.

Description and number of specimen.			Year of growth.	Amount of fresh substance in grains.	Per centage of ash in fresh substance.	Per centage of ash in dried substance.	Grains of ash employed.	Amount of oxide of copper in grains.	Reagent or process.
Wheat straw.	I	R.E. Unmanured	1851	1749·4	5·71	6·78	100·0	0·010	Electrolysis.
	II	„ „	1852	1626·2	6·14	7·41	100·0	0·007	„
	III	„ Farm-yard manure	1851	1731·3	5·77	6·76	100·0	—	Needle.
	IV	„ „	1852	1672·2	5·98	7·24	100·0	—	„
	V	„ Mineral and ammoniacal	1851	2628·8	3·80	4·50	100·0	—	„
	VI	„ „	1852	...	...	5·78	100·0	—	„
Barley straw.	I	R.E. Unmanured	1854	2670·9	3·74	4·56	100·0	—	Needle.
	II	„ Farm-yard manure	1854	2408·4	4·15	5·05	100·0	—	„
	III	„ Mineral and ammoniacal	1854	2100·8	4·76	5·80	100·0	—	Ferrocyanide of Potassium.
Mangold wurtzel bulb.	I	R.E. Moderately manured ...	1849	...	...	...	100·0	0·008	Electrolysis.
	II	„ Unmanured........	1850	...	...	...	100·0	0·008	„
Swede turnip bulb.	I	R.E. Unmanured	1850	10266·9	0·48	4·43	50·0	0·005	Electrolysis.
	II	„ Mineral manure	1850	8756·5	0·57	5·09	50·0	0·002	Electrolysis + Sarzeau.
	III	„ Mineral and organic ...	1850	8865·2	0·56	5·73	50·0	0·003	Electrolysis.
Swede turnip leaf.	I	R.E. Unmanured	1850-1-2	...	...	...	30·0	0·002	Electrolysis.
	II	„ Mineral manure	1850	2610·9	1·91	14·11	50·0	0·002	„
	III	„ Mineral and organic ...	1850	2944·6	1·69	12·85	50·0	0·003	„

Animal substances.—We have examined, at different periods, twenty-nine specimens of animal tissue or fluid, with a view to the detection, and sometimes to the estimation, of copper. The results are represented in the following table. In the column of reagents, whenever an iron wire is referred to, it has been used electrolytically, as shown in the accompanying diagrams.

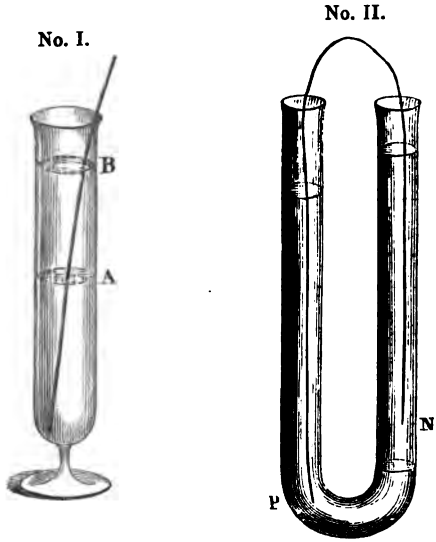


Diagram No. I represents a straight tube containing two layers of liquid, the under layer being the prepared solution of ash, the upper layer being strongly acidified water, poured carefully on to the other layer so as to avoid mixing. The iron wire standing in the tube, being thus in contact with two different liquids, an electrolytic action is set up, the upper end of the wire in contact with the strongly acid solution becomes the electro-positive pole and rapidly dissolves, while the lower end becomes the electro-negative pole and becomes rapidly coated with copper. Diagram No. II represents a similar arrangement, except that a bent or U tube is employed. In this case the cupric solution has a low specific gravity, and floats upon the strongly acid solution, which has had its specific gravity heightened by means of common salt. These arrangements afford elegant illustrations of electrolytic action, but, save in the some-

what more rapid production of the deposit, they do not seem to present any advantage over the steel needle. In the estimations where this iron wire process was resorted to, the deposited copper was always re-dissolved in nitro-hydrochloric acid, and the solution evaporated down, rendered ammoniacal, filtered, acidulated with hydrochloric acid, and submitted in a decomposing cell to the electrolytic action of a Smee's or Daniell's battery, having a platinum wire for its negative pole, as previously described.

Number.	Description of specimen.	Amount of fresh substance in grains.	Percentage of ash in fresh substance.	Grains of ash employed.	Amount of oxide of copper in grains.	Reagent or process.
I	Human liver	...	...	...	—	H.S. Zinc and Platinum.
II	,,	3160	0·89	28·38	—	Electrolysis.
*III	,,	3246	1·22	39·74	0·006	Iron wire + Electrolysis.
IV	,,	6463	0·94	61·22	—	Electrolysis.
†V	,,	6925	1·09	75·69	0·013	,,
VI	,,	6787	0·94	66·73	—	Needle.
VII	Sheep's liver	11529	1·08	125·45	0·515	Iron wire + Electrolysis.
VIII	,,	6682	1·37	91·96	0·281	Electrolysis.
*IX	Human kidney......	2715	0·85	23·14	0·010	Iron wire + Electrolysis.
X	,,	1830	0·85	15·64	0·015	Electrolysis.
†XI	,,	1594	1·11	17·80	0·006	,,
‡XII	,,	2546	1·03	26·34	0·005	,,
XIII	Sheep's kidney ...	804	1·24	9·98	—	Needle.
XIV	,,	1170	1·19	14·02	—	Electrolysis.
‡XV	Human spleen	1532	1·27	19·59	trace.	,,
*XVI	Human blood	2666	0·83	22·28	none.	Iron wire.
†XVII	,,	1340	0·90	12·17	trace.	Needle.
XVIII	Sheep's blood	12575	0·90	114·20	0·003	Electrolysis.
XIX	,,	5720	...	...	none.	Needle.
†XX	Human muscle......	1598	1·03	16·56	trace.	Elelcrolysis.
XXI	Beef steak	9440	1·09	103·59	—	,,
XXII	Four eggs	2826	0·91	25·82	—	Needle.
XXIII	Gloster cheese	7000	..	...	—	H.S. Zinc and Platinum.
XXIV	Cheddar cheese ...	3650	4·35	159·11	0·002	Electrolysis.
XXV	Mussels	...	...	...	—	Needle.
XXVI	,,	2044	1·97	40·36	none.	,,
XXVII	Ox bile...............	2900	1·12	32·68	none.	,,
XXVIII	,,	3354	1·16	39·27	—	,,
XXIX	,,	3307	1·31	43.54	—	,,

Specimens, Nos. III, IX, and XVI; Nos. V, XI, and XVII; and Nos. XII and XV; belonged respectively to the same individuals. The weights of the entire livers were as follows:

Number of specimen.	Total weight of liver in grains.	Quantity of liver taken.	Amount of oxyde of copper in entire liver.
I	...	...	—
II	20125	3160	—
III	19250	3246	0·035
IV	24718	6463	—
V	15750	6925	0·029
VI	...	6787	—
VII	11529	11529	0·515
VIII	14053	6682	0·590

The majority of the experiments were performed occasionally at different periods of the years 1857 and 1858. Precautions were always taken to ensure the purity of the reagents. The experiments with the sheep's liver, No. VII, in which so much copper was found, were performed in July, 1857, at the same time, in the same manner, and with the same reagents as the specimens of human blood, Nos. XVI and XVII, and of human muscle, No. XX. The experiments with the sheep's liver, No. VIII, in which a still larger amount of copper was found, were performed in August, 1858, at the same time, in the same manner, and with the same reagents as the specimens of human spleen, No. XV, of sheep's blood, No. XIX, and of mussels, No. XXVI. The fully incinerated ashes of these two livers, and of several other of the specimens, had a perceptible bluish tinge; and the ammoniacal filtrates, obtained after supersaturating the acid solutions of the respective ashes with ammonia, were in these two cases, and in several others, of a decided blue colour. In the sheep's kidney, No. XIII, in order to avoid every possible fallacy, the experiment was reduced to a minimum of complication. The kidney, uncut and unbroken, was put into a large platinum capsule, partially dried in a water-bath, and then incinerated. The ash was not removed from the capsule, but was rubbed down in the capsule with an agate pestle, was burnt to thorough whiteness, dissolved in hydrochloric acid and water, and the solution, after evaporation to a small bulk, transferred to a test-tube. A steel needle immersed in the liquid, became well coated with copper in the course of half an hour. The solution of the ash, and the coating

of the needle, were performed in the presence of Dr. Taylor and Mr. Scanlan, who expressed themselves satisfied as to the presence of copper in that particular kidney. The water, hydrochloric acid, and platinum capsule, were specially tested for copper. In reference to the specimen of Gloster, cheese No. XXIII, symptoms of irritant poisoning had in several instances followed its ingestion. The ash was furnished us by Mr. Nesbit, for examination. The hydrochloric acid yielded a slight brown precipitate with sulphuretted hydrogen. A portion of this precipitate was dissolved in hydrochloric acid, the solution transferred to a small platinum capsule, and a piece of zinc introduced, so as to touch the platinum through the liquid. There was left on the platinum a very unmistakeable cupric deposit, which dissolved in ammonia with a blue colour; and this solution, after neutralization, gave a chocolate precipitate with ferrocyanide of potassium. In another portion of the sulphuretted hydrogen precipitate the presence of lead was recognised. But the two metals occurred in very minute quantity; in our opinion quite insufficient to have caused the irritant symptoms observed. No suspicion attached itself to the other specimen of cheese, No. XXIV. The rind of the cheese was carefully avoided.

The specimens of mussels, No. XXV, was furnished us by Dr. Burton Brown. They were nine in number, had been boiled in a tin saucepan, and were the residue of some that had caused symptoms of poisoning. In the course of twelve hours, a needle immersed in the acid solution of the ash, became coated with copper. In the other specimen of mussels, twenty-one in number, which we obtained fresh for the purpose, we were unable to detect a trace of copper. But there can be no doubt, from the researches of many chemists, that mollusks do sometimes contain copper to a very considerable extent, and that they can thrive in waters largely contaminated with copper. Dr. Sullivan, of Dublin, informed us, that in oysters from the coast of Cornwall, some of which had caused symptoms of irritant poisoning, he had recognised very considerable quantities of copper, though the oysters were plump and in good condition. In the specimens of ox-bile, Nos. XXVIII and XXIX, we found but very small quantities of copper, much less than the results of our liver experiments

had led us to expect. In specimen No. XXVII, we failed altogether; but, we believe, rather from an inadvertence in our manipulation, than from the absence of the metal. Our experiments are in favour of the following conclusions:

1. *That the tissues, particularly of the liver and kidney, usually contain copper in very notable quantity.*

2. *That the blood usually contains but very minute traces of copper.*

3. *That copper may sometimes be extracted from the liver by boiling water.* About a quarter of the human liver, No. IV, was boiled for three hours with distilled water. The liquid was filtered through fine filtering paper, evaporated to a small bulk, transferred to a test-tube, and acidulated with hydrochloric acid. A needle immersed in the liquid became well coated with copper in the course of twelve hours. A precisely similar experiment was made with 4404 grains, or rather less than a third of the sheep's liver, No. VIII. The result was equally decided. The distilled water and hydrochloric acid were specially tested for copper.

4. *That diluted hydrochloric acid can sometimes extract copper from the liver.* The liver, No. I, belonged to a girl, on whose body an inquest was held by Mr. Lewis, the coroner for Essex. The girl had evidently died from phthisis, but a suspicion of poisoning had been excited, and the viscera were forwarded to one of us (Dr. Odling), for examination. No poison was detected in any organ save in the liver, the dilute hydrochloric decoction of which gave a slight pale brown precipitate with sulphuretted hydrogen. This precipitate was dissolved in hydrochloric acid, filtered into a small platinum capsule, evaporated down, and electrolysed by means of a piece of zinc touching the platinum through the liquid. A slight, but evident, cupric deposit was produced, forming with ammonia a blue coloured liquid, from which, after neutralization, ferrocyanide of potassium threw down a chocolate precipitate. About a quarter of the liver, No. IV, was boiled in dilute hydrochloric acid, the filtered decoction evaporated to a small bulk, and treated with a steel needle, which gradually acquired a tolerably thick coating of copper. The undissolved residue filtered off from the clear decoction, was washed once or twice with water, and burnt to a white ash, in which a mere trace

of copper was detected, very much less than that which had been obtained from the hydrochloric decoction. The 4404 grains of sheep's liver, No. VIII, that had been extracted with water, were afterwards boiled with dilute hydrochloric acid, and the filtered decoction evaporated down. The evaporation was carried somewhat too far, and a slight charring, or rather browning of the liquid took place. A steel needle, immersed in the thick liquid for twenty-four hours, presented no indications of copper. The liquid was then diluted with twice its bulk of water, so as to render it freely mobile, and the needle again introduced for twenty-four hours, but with no success. The liquid was then evaporated to dryness, and burnt to a gray ash. This ash was dissolved in hydrochloric acid, and supersaturated with ammonia. The ammoniacal filtrate had a dark blue colour, and after acidulation coated a needle thoroughly in the course of a few minutes. The above-described effect of a slight charring in preventing the manifestation of copper is very peculiar. The residue of the liver undissolved by the hydrochloric acid yielded an ash containing copper.

5. *That in cases where copper can be readily detected in the fully incinerated substance (white ash), it is not to be extracted by hydrochloric acid from the merely charred substance (black ash), even after its exposure for some time to red heat.* The specimen of human liver, No. VI, was charred, and the charred mass after pulverisation kept at a red heat for some length of time in an open capsule. This black powder was boiled with hydrochloric acid, but from the hydrochloric solution not a trace of copper could be extracted. The black residue undissolved by the hydrochloric acid was then burnt nearly to whiteness, and again treated with hydrochloric acid, whereby a solution was formed, which speedily yielded a complete coating of copper to a steel needle immersed in it. Again, 2967 grains of the sheep's liver, No. VIII, so rich in copper, were burnt; but from the black ash no trace of copper could be obtained by extraction with hydrochloric acid. The exhausted residue was then burnt nearly to whiteness, and this ash, by treatment with hydrochloric acid, gave a solution which, when supersaturated with ammonia, had a distinctly blue colour; and the ammoniacal filtrate, after acidification, coated a steel needle with copper in the course of a few minutes.

There is no difficulty as to the source of the copper that finds its way into organic tissues. We know that copper is a very widely distributed element, that it is a frequent accompaniment of iron, that it exists in sea-water and in very many soils. We have found traces of copper in yellow ochre and in sienna brown. Mr. Staunton, of Bangor, has lately found copper in a specimen of pipe-clay, and we had an opportunity of confirming his result. Mr. Riley recently recognised the presence of copper in a peat-water from Dowlais. Professor Mallet, of the University of Alabama, U.S., mentioned to us the fact, that in analysing, some years ago, several specimens of soil from Western Massachusetts, he was struck by the occurrence in one specimen of an easily recognisable quantity of copper; and on specially examining the others, he succeeded in detecting the metal in every instance. The rocks from which these soils were derived were of early geological age, but contained no workable copper veins. Similar facts have been noticed by other observers, particularly by Walchner.[1]

Our intention was now to give a critical *resumé* of the various researches that have been published from time to time upon the subject of normal copper. But finding, though not until we had made some progress in our task, that we had been anticipated to a very considerable extent by Chevallier and Cottereau,[2] we content ourselves, at any rate for the present, by referring to the two earliest papers on the subject, those of Meissner and Sarzeau. It seems that in the latter part of the last century, the existence of copper in organic tissues and products had attracted the attention of Margraff,[3] Gahn,[4] and Vauquelin,[5] successively; but it is from the researches of Bucholz[6] and Meissner,[7] that we date our first reliable knowledge of normal or constitutional copper.

[1] Vide 'Comptes rendus,' 23, 12.

[2] 'Essais historiques sur les metaux que l'on rencontre quelquefois dans les corps organisés,' par MM. A. Chevallier et E. Cottereau. ('Annales d'hygiène publique, année 1849, tome xli, p. 387.)

[3] Quoted by Chevallier and Cottereau, op. cit.

[4] Quoted by Sarzeau, op. cit.

[5] Quoted by Sarzeau, op. cit.

[6] Quoted by Meissner, op. cit.

[7] 'Versuche über den Kupfer gehalt einiger Pflanzenaschen,' Von Dr. W. Meissner (Schweigger's 'Journal der Chemie,' Jahr, 1816, Band xvii, s. 340, 436); also in h e 'Annales de Chimie et de Physique,' Année 1816, tome iv, p. 106.

Meissner's researches.—It appears that Bucholz and Meissner had previously detected copper in the root-fibres of zedoary, and in the pods of vanilla, when in the year 1816 the latter chemist continued the inquiry, and published two papers on the subject in Schweigger's 'Journal der Chemie.' Meissner adopted the following process: He incinerated the substances under examination, washed the ashes with water, boiled the insoluble residue with hydrochloric acid, nearly neutralised the solution with ammonia, and then immersed in it a thin plate of iron or zinc, which acquired a coppery appearance in the course of one or two days. By this means he recognised the presence of copper in the following quantities of different vegetable substances.

Grains of Paradise (*Amomum granum Paradisi*) .	1000 grains.
Lesser cardamoms (*Elettaria cardamomum*) .	500 ,,
Root of long turmeric (*Curcuma longa*) .	2000 ,,
Root of galanga (*Alpinia galanga*) . .	2000 ,,
Root of sweet flag (*Acarus calamus*) . .	2000 ,,
Stems and leaves of wild rosemary (*Ledum palustre*)	2000 ,,
Root of salep (*Orchis mascula*) . .	2000 ,,
Black pepper (*Piper nigrum*) . .	2000 ,,
Nux vomica seeds (*Strychnos nux vomica*) .	2000 ,,
Colocynth (*Citrullus colocynthis*) . .	2000 ,,
Cascarilla bark (*Croton eleuteria*) . .	2000 ,,

To the conclusion of his second paper Meissner appended the following propositions: "That the ashes of different parts of plants, both foreign and domestic, are by these experiments proved to contain a demonstrable quantity of copper. That in plant-ashes the copper seems to be associated with the iron. That in future analyses of plant-ashes, due regard must be paid to the presence of copper." Meissner expressly stated that though the copper was recognisable both by chemical reagents and by the electric current, still it existed in too minute a quantity to allow of quantitative estimation.

Sarzeau's researches.—In 1830, Sarzeau[1] (of Rennes) published, in the 'Journal de Pharmacie,' an account of some experiments in which he had estimated the amount of copper

[1] 'Sur le présence du cuivre dans les vegetaux et dans le sang,' par M. Sarzeau ('Journal de Pharmacie,' année 1830, série I, tome xvi, p. 505.

present in several vegetable substances, and also in blood. He does not appear to have made more than one examination of each particular substance. His process was as follows: The substance was incinerated, the ash dissolved in nitric acid; the solution precipitated with excess of ammonia; the ammoniacal filtrate treated with ferrocyanide of potassium, and carefully neutralized with dilute acid, whereby the ferrocyanide of copper was precipitated. This was collected, washed, dried, and calcined, and the residue of the calcination treated with dilute sulphuric acid. The solution of sulphate of copper thus obtained was supersaturated with ammonia, filtered, concentrated by evaporation, and acidulated with sulphuric acid. Into it was then immersed a polished slip of iron, upon which, after some time, copper was deposited. By the action of some additional acid, the copper was readily detached from the iron, and was collected, washed, dried, and weighed. The process, as Sarzeau himself showed, is not absolutely accurate in reference to the exact amount of the copper, but the errors must be extremely small. By this process Sarzeau obtained the following results:

Substance examined.	Number of grains taken.	Grains of ash obtained.	Grains of copper obtained.
Grey cinchona bark	7716·3	203·7	0·038
Dried madder	7700·7	787·0	0·031
Martinico coffee (fine green)	7716·3	313·6	0·062
Bourbon coffee (golden yellow)	7716·3	275·5	0·062
Coffee dregs	3950·7	180·5	0·057
Wheat	23148·9	452·8	0·108
Flour	23148·9	121·4	0·015
Bran	7716·3	—	—

The 3950·7 grains of coffee-dregs resulted from an infusion of 8009·5 grains of coffee. In the infusion itself Sarzeau was unable to recognise the presence of copper. In the case of the bran an accident prevented the estimation of the metal which, however, appeared to exist in much larger proportion than in the flour. From this circumstance, and from failing to detect copper in 15432·6 grains, or rather more than 2½ lbs. avoirdupois of potato-starch, Sarzeau concluded that the starchy part of wheat-grain is free from copper, and that

bread made from coarse flour contains the metal in the largest proportion. On the other hand, he found 7716·3 grains of rice to yield traces of copper.

In reference to the presence of copper in flour, and consequently in bread, Sarzeau has made the following curious calculations. The population of France is estimated at thirty millions. We will suppose that each individual eats on the average 600 grammes of bread daily (= 9259·5 grains, about 1lb. 5 oz. avoirdupois), or in other words, that he consumes 500 grammes of flour (= 7716·3 grains, rather more than 1lb. 2 oz. avoirdupois). The quantity of bread daily consumed in France will thus be eighteen millions of kilogrammes, corresponding to fifteen millions of kilogrammes of flour (= 277786·8 millions of grains, or 39·6 millions of lbs. of bread; and 23418·9 millions of grains, or about thirty-three millions of lbs. of flour.) But these fifteen millions of kilogrammes of flour contain ten kilogrammes of copper that are eaten every day (= 154,326 grains, or 22 lbs. of copper daily.) Multiplying this last weight by 365, we perceive that the quantity of copper contained in the bread necessary to sustain France for one year, amounts to 3650 kilogrammes (=55,318990 grains, or 3 tons, 11 cwt., 3 qrs., 9 lbs., and 9 oz.) Sarzeau calculating roughly that wheat yields three-fourths of its weight of flour, and one fourth bran, increases the above amount by one fourth to represent the quantity of copper abstracted from the soil by the grain, and winds up with an exclamation: "Resultat enorḿe, qui prouve autant l'abondance du cuivre dans le sol que son extrème division !" Sarzeau likewise detected copper in tea, oats, barley, rye, and buck wheat; also in some Malambo bark, received by Vauquelin, from Humboldt and Bonpland; but, in all these cases, the quantity of substance operated upon was too small to allow of any estimation being made. He was also able to recognise the presence of the metal in 12330·6 grains of dried ox-blood, obtained from 660440· grains of fresh blood. The ash weighed 412·4 grains, of which 312·9 grains were soluble in water, and free from copper. The insoluble portion, after re-incineration, weighed 71·7 grains; it was dissolved in nitric acid, and supersaturated with ammonia. From the ammoniacal solution 0·046 grains of copper were obtained.

Since the publication of Sarzeau's paper, copper has been found as a frequent, if not an invariable constituent of different animal tissues, by several of the most distinguished French toxicologists, particularly by Devergie, Orfila, Chevallier, Lassaigne, and Millon. On the other hand, its presence, save in exceptional cases, has been denied most strongly by Danger and Flandin, whose opinions were supported to a considerable extent by Chevreul and Pelouze. Moreover, Dr. Taylor has expressed himself in favour of Danger and Flandin's views. For our own part we are scarcely prepared to maintain that copper is a necessary and invariable constituent of living organisms; but we affirm most positively that it does very frequently occur in certain vegetable and animal tissues, particularly in those of the kidney and liver, in which last-named organ more especially it sometimes presents itself in very considerable quantity. We will conclude by a quotation from Dr. Christison's work 'On Poisons,' as expressive of our own views on the subject. "On the whole, whatever may be thought of the physiological question, whether copper forms a constituent of the textures and fluids of vegetables and animals, it seems well established that the metal is often present there in minute proportion; and, consequently, its possible presence must not be overlooked in medico-legal researches."

A

COLLECTION OF SEVERAL CASES OF

CONTUSIONS OF THE ABDOMEN,

ACCOMPANIED WITH

INJURY TO THE STOMACH AND INTESTINES.

By ALFRED POLAND.

A STRIKE, kick, or fall on the abdomen—a passage of a wheel over it, or a jamb between two opposing bodies, &c., must never be judged lightly of, and must always be regarded with suspicion, and treated in a careful and judicious manner. Many a trivial blow in this region has resulted in unexpected and sudden death, although sometimes life has been prolonged for a short period in agony and suffering, terminating in protracted collapse, or else in subsequent fatal inflammatory mischief. This can be readily accounted for, when we consider the numerous and vital structures contained in the abdomen; a serous membrane highly prone to inflammation, the "peritoneum," occupying an extensive amount of surface; a lengthy coil of organised tubing, "the stomach and intestines;" solid substances, made up chiefly of blood-vessels, &c., "the liver, spleen, and kidneys," readily lacerable and liable to rupture, causing nearly always fatal hæmorrhage; receptacles for fluid, "the gall- and urine-bladders," which under distension and undue force may burst; large vessels coursing along the posterior wall, "the aorta, vena cava, &c.;" and lastly, above all, the sympathetic nerves, consisting of the solar plexus and its

numerous satellite plexuses and branches, of such high organic importance, that injury or shock thereto may be attended with irreparable results.

All these structures, organs, &c., are moreover inclosed within soft, elastic parietes, capable of great distension, which although readily able to resist shock and external violence without injury to themselves, yet may allow the force to be transmitted and expended on the contents with dire effect, and yet without leaving a trace or mark on the exterior.

In the present communication we shall not allude to sudden death following blows upon the abdomen where there is not detected any appreciable lesion of the contents after death. Such cases are not unfrequently met with, and may require the testimony of the surgeon for verification. Several are recorded in the works on Medical Jurisprudence, and in Watson's work on 'Homicide;' and these have generally involved the question of manslaughter or murder. It is assumed that the death in these instances is due to the shock to the nervous system. The most unique case of the kind is that one quoted in almost every surgical work, and related in the entertaining lectures of Sir Astley Cooper. We shall quote it, as bearing upon the present communication. "Two men were working near the East India House, one of whom had a heavy load, which he was wheeling along; his comrade said to him, 'That is too much for you, stand aside, and let a better man take it.' He accompanied this remark with a slight blow on the scrobiculus cordis, and the man immediately let the barrow fall from his arms; he felt a severe shock, and the sudden impulse made so strong an impression on the heart's action as to stop it, and, without complaining of pain, the man died on the spot. On examination, no lesion could be detected." Such is the account given. Perhaps, now-a-days, some clue might have been suggested and unravelled as the real cause of this sudden death; were a case of the kind submitted to the tests of the present advanced pathological knowledge, a fatty heart might explain all.

We shall also pass over blows and contusions of the abdomen followed by peritonitis; and here likewise without visceral lesion. These cases are by no means unfrequent in hospital practice, and often appear in the records of the public

journals. They are chiefly to be found in the works on jurisprudence. They constitute ordinary traumatic peritonitis.

Thus, then, although blows on the abdomen may cause sudden death without appreciable lesion, or may be followed by uncomplicated traumatic peritonitis, yet, in by far the majority of instances of these classes of injuries, some internal rupture or lesion almost always takes place, and in such cases life is seldom extinguished at once, but prolonged for a more or less short period, and ending fatally either in protracted collapse, or in fatal internal hæmorrhage, or in subsequent severe peritonitis; few rarely recover, and these only from circumstances of an extraordinary character.

The class of cases we intend to illustrate in our present number are injuries of the stomach and intestines. We shall first of all give a general view of such injuries, and then take other individual parts of the canal in more extensive detail.

The stomach and small and large intestines, are for the most part composed of the same structures, an external serous, a middle muscular, and an internal mucous coat, with intervening layers of membrane.

Injuries to this tubing may be followed by acute or chronic inflammation of the coats, causing what is termed traumatic gastritis, enteritis, and colitis; these we shall but cursorily advert to, as they generally fall under the cognizance of the physician, and are detailed by him in works on medicine.

The more common, and unfortunately the more fatal effects of a blow on these structures, are rupture of their coats; and rarely is the laceration confined to one coat; would that it were so, but alas, the force rents and tears asunder the whole of the coats, and thus allows the escape of the contents (harmless while in the bowel) into the peritoneal cavity, setting up immediate peritonitis of the most intense and frightfully agonising form.

Before detailing the cases collected for this monograph, we will advert to a few of the more leading features that generally take place in lesion of these organs; so that we may be enabled to estimate the variety of symptoms which often occur, and clear up some of the anomalies that exist; in one case a patient becomes immediately collapsed, and in another he is

able to walk some distance; one will die in a few hours, another not until three or four days; one will suffer most intensely, while another will be comparatively easy. Thus, then, we must take a standard set of symptoms of the effects of ruptured bowel, and we shall then be enabled to appreciate more correctly why some exceed the standard laid down, while others hardly come up to it.

The effects of a ruptured bowel may be divided into two distinct periods and phases; first, the primary effect or general constitutional disturbance or constitutional irritation; and, secondly, the secondary effects, or the inevitable after consequences, viz., severe peritonitis.

1. *The primary effects*, or the stage previous to the setting in of inflammation. This is but of short duration and rarely witnessed in ordinary hospital practice, unless the injury should have occurred close at hand. There is in the first instance, a momentary feeling of a blow, the patient gets up, but is soon seized with a peculiar depression of the nervous system—a kind of faintness—rapidly succeeded by rigors, chilliness, &c., ending in confirmed collapse. Slight reaction ensues, when the patient complains of excruciating pains at the seat of injury; this becomes intense and agonising, and soon of a burning character, is unremitting, and radiating to all parts of the abdomen; there is great distress and anxiety, and the features deadly pale and anxious, expressive of mortal injury; vomiting next takes place, and the abdomen becomes either distended and tympanitic, or flat and rigid, the walls becoming rigid and hard from muscular contraction. Retention of urine is generally, but not always present. All these reactionary symptoms are for the most part due to the extravasation of the contents of the tube into the peritoneal membrane, and this for the most part modifying the effects, as seen in the varied characters of symptoms in the various cases adduced. Thus, *firstly, the size of the rupture* will regulate the extent of effusion; this may be to the extent of a pin-hole or few lines, when effusion seldom ensues; whereas when one third or two thirds of extent of circumference, it almost necessarily takes place; but when completely torn across, the most inevitable fatal issue results, viz., separation of the divided end, and solution of continuity thereof hopelessly frustrated.

Secondly, the state or condition in which the ruptured bowel happens to be at the time; if empty and contracted, the rent will be small, and little or no effusion take place, and, with due care, capable of repair; whereas, if distended with food or fæces, or air, the rupture will be greater, and almost inevitably accompanied with escape of the contents into the peritoneum.

Thirdly, the symptoms are modified according to the part injured. Thus those attending injury to the stomach are most severe, next those of the duodenum, then the jejunum, afterwards the ileum, and lastly the larger intestine.

Lastly, much will depend on the quietude and rest of the patient after the accident; if kept in a recumbent position and carefully carried, so as not to cause displacement of the viscera, nature may have some chance of glueing the ruptured spot to the neighbouring parts; but when he gets up and attempts to walk, the injured bowel is displaced, the contents pour out, and immediate collapse is the result. So also in the administration of drinks, &c.; if the patient be left alone, and be allowed nothing whatsoever, then there will be a hope; should, however, water or wine and water be given to allay the thirst, this must necessarily distend the bowel, set it in action by causing peristaltic motion, and finally allow its escape through the rent into the peritoneum.

The collapse may continue and end in death, without any reaction, but generally the latter sets in, and lasts but for a short period, when the—

2. *Secondary effects* rapidly develop themselves, in from six to twelve, or even twenty-four hours. These consist in all the formidable symptoms of traumatic peritonitis. Peritonitis is familiar to us all, but, for sake of conformity and contrast, we will cursorily enumerate the leading characters.

I. Local signs.

1. *Pain* of an unmistakeable, acute, agonising, almost unbearable kind, commencing at and about the seat of injury, and soon extending itself rapidly over the whole abdomen. Subsequently it becomes so aggravated, that the slightest movement, or pressure, or contact of anything, induces torments; even the efforts at vomiting, or making water, or passing a motion, distresses. This is often modified, for in

some the pain is more bearable, in others it comes on in paroxysms, in others it may be altogether absent; but these must be considered as exceptions.

2. *Heat.*—There is a sensation of burning and pungency, almost like the cutting of a knife.

3. *Tension and tympanitis;* and here we have a complication. If this comes on immediately on the receipt of the injury, it is due to the escape of air from the ruptured bowel, and is often a good test, when it exists, of probable rupture. Where it does not come on until after peritonitis has set in, it may still be due to escape of air; but may also be owing to distension of the large or small bowel, from loss of tone, in association with a naturally flaccid abdomen.

4. *Rigidity,* owing to contraction of the abdomen. Not always present, and may accompany ruptured bowel previous to peritonitis setting in. It is more especially observed in muscular and well-developed persons, and often prevents distension and tympanitis.

II. The constitutional signs modified by those of ruptured bowel.

1. *The Position.*—Patient lies on back, with legs drawn up, and avoids the least motion.

2. *Countenance* peculiar and well marked, anxious, haggard, shrunken, and pale.

3. *Digestive system.*—Nausea; vomiting, first of the contents, then of the fluids which have been administered, and afterwards colourless and greenish fluids; thirst; constipation.

4. *Respiratory system*—Thoracic and hurried.

5. *Circulatory system* disturbed; pulse peculiar and indicative, being frequent, small, wiry, hard, and incompressible.

6. *Secretions and excretions* modified and partly suppressed; skin hot and dry; kidneys, secretion scanty and thick.

7. *Nervous system* depressed.

Such, then, are the primary and secondary symptoms evinced by ruptured bowel.

We will now advert to the *results or termination.*

A. *Death* is the general result, and may occur in the primary stage during the collapsed state; or it may take place from the subsequent peritonitis.

B. *Recovery*—of but seldom occurrence. Still it is possible,

and will depend for the most part on the extent of the rupture and the plan of treatment adopted.

Repairs may take place, 1st, by adhesion of the rent to the neighbouring parts.

2d. By plug of omentum filling up gap and preventing effusion, see Jobert's case, and others in the appended tables.

3d. The effusion may be circumscribed; abscess may follow, and artificial anus or fistula induced.

Prognosis always unfavorable.

Diagnosis.—Protracted collapse on receipt of blow—little or no reaction; intense agony, tympanitis; blood in vomited matters or in stools, rapid peritonitis and exhaustion, with no evidence of internal hæmorrhage, viz., by blanched appearance of surface and mucous membrane.

TREATMENT.—I. *The Collapsed Stage.*

1. Never give a drop of fluid or a particle of solid food, for forty-eight hours at least—this is the golden rule. The thirst and distressed state to be allayed by moderate use of ice to suck, in small quantities and at prolonged intervals, so that no fluid should be generated to any extent. If ice cannot be had, a fine handkerchief dipped in cold water allowed to be sucked at intervals.

2. *Powdered opium* mixed with a little butter may be administered, about one grain every four hours: this tends to allay pain and prevent peristaltic action of the bowels.

3. *No calomel,* or purgatives, upon any condition whatever; for they will only excite peristaltic action, and thus prevent the adhesion so necessary for cure.

4. *No stimulants;* for the collapsed state is essential. Stimulants truly cause reaction, but are almost immediately followed by aggravation of symptoms and inevitable induction of peritonitis.

The treatment, then, consists in: 1st. Perfect rest and quietude in the recumbent position: 2d. Starvation for at least forty-eight hours, allowing only the occasional use of ice: and 3d. Administration of opium, to quiet the system, allay sense of hunger, and prevent peristaltic action.

II. *In the Inflammatory stage.*

1. *Local* measures. Leeches to the abdomen, freely and unsparingly used, and commenced immediately when the pain

after peritonitis sets in, and replaced by hot fomentations, to be repeated with judgment and without fear. Counter-irritants, blisters, &c., only aggravate the mischief, and the application of mercurials has not been attended with any good effect.

2. *Constitutional.*—Still to continue the ice and opium, and after the forty-eight hours have expired, the administration of concentrated essence of beef-tea, given in teaspoonfuls at a time at intervals of ten minutes, so as to enable the stomach to take it up almost entirely. Enemata of beef-tea, and nourishing fluids may also be given, and if much depression and exhaustion, wine may be mixed with it or beat up with egg. This should be carefully adhered to until the fifth day, when we may commence with a cautious use of blood-nourishing fluid diet, in small quantities and frequently.

We shall now take into consideration the injuries to the intestines in the following order:

A. Injuries to the stomach.

B. Injuries to the small and large intestines, comprising, duodenum, jejunum, ileum, cæcum, and colon.

A. Contusion attended with Injury to the Stomach.

The stomach is seldom the seat of mischief; when empty it is almost entirely in left hypochondrium, but extending into epigastrium as far as right hypochondrium. It is protected in front by lower ribs and diaphragm, latter separating it from heart; by the liver, which is more or less prolonged over it, and in some rare cases by the gall-bladder. It is only in the epigastrium at the scrobiculus cordis, that it comes in contact with the parietes, and thus often the transverse colon and great omentum may intervene, especially when stomach is empty, and the colon distended with air; when, however, the stomach is distended, it overlaps the colon.

The results of a blow may be—

I. *Inflammation of the stomach,* called traumatic gastritis, and generally coming under the cognizance of the physician. The symptoms are the same as idiopathic gastritis, or gastritis following irritating poisons, viz., constant nausea and sickness, craving for water and cold drinks, which as soon as taken, are

immediately vomited up, intense thirst. Severe local pain on pressure in region of stomach; there is febrile disturbance, a hot skin, a frequent, small, soft pulse, tongue white and furred; respiration more or less hurried; bowels costive; urine scanty and high coloured. There is faintness or prostration, the countenance pale and expressive of distress. The patient rapidly emaciates, the countenance is shrunk, and eyes sunken, extremities become cold, drowsiness and supineness, delirium, stupor. Death.

Diagnosis from local peritonitis difficult, there is pain on pressure over the stomach which is exquisite, and extending beyond that region.

II. *Chronic Inflammation.*—This also we shall not enter upon in detail, but merely refer to two interesting cases, as connected with injuries to the abdomen from blows. In both external fistulous openings, connected with the stomach, resulted from chronic inflammation.

Injury to Stomach.—Subsequent Abscess and Fistulous opening.

Ettmüller, in the 'Act. Phys. Med. Acad. Cæs. Nat. Cur.' (vol. iii, p. 170), published at Nuremberg, for the year 1733, gives an instance. A single woman, aged 30, the housekeeper of a very celebrated man consulted me last year, in reference to a hole about the size of a large pea in her left hypochondriac region, surrounded by inflamed and indurated integument, and giving issue to portions of her food and drink. She referred this indirectly to a fall against the top of a post, which happened to her when she was only ten years old. After the injury, an indolent swelling appeared over the stomach, which eventuated in the fistulous opening. Her exercise and active habits appeared to prevent this from closing. On changing her mode of life, and confining herself for a few weeks to bed, the fistula contracted, and she is now, says the report, getting on prosperously.

M. Richerand gives another case. This patient was also a female, aged 47. The opening, as in the foregoing instance, had resulted from an indolent swelling, caused by a local injury many years before its breaking. The fistula was seated at the upper and left portion of the epigastrium. It was of an oval form, eighteen lines long by rather more than one inch wide, allowing the inner surface of the stomach to

be seen through it. She became a patient at La Charité, under the care of M. Corvisart. At this period her appetite was equal to that of three ordinary women of her age. The fistula had existed about nine years. Three or four hours after eating she was usually obliged, from a sense of uneasiness, to remove the compresses with which she covered the fistula, to give issue to the contents of the stomach. After this escape of food, which was discharged with a considerable quantity of gas, she was accustomed to wash out the stomach with an infusion of chamomile. This quieted her, and enabled her to sleep. Her bowels were habitually constipated; her urine was small in quantity; her pulse was weak, and rarely over forty-six beats in a minute; she was feeble and emaciated, probably from want of nourishment; only a small portion of the food which she took passed beyond the pylorus. She died of a colliquative diarrhœa six months after her admission into the hospital. The stomach was found intimately united to the abdominal parietes. The opening into it was at the union of the two left thirds with the right third; or about eight fingers' breadth from its great extremity, involving only the pyloric portion. No other organic lesion was discovered.[1]

III. *Rupture of coats of stomach* are very rare. The force of blows in its region seem to be expended chiefly on ribs and liver, hence the frequency of the latter organ being injured; it is less capable of resistance, from the nature of its structure and position. The stomach, however, is deeply placed, and only liable to injury when distended.

The coats may be completely ruptured, allowing egress of contents, or the rupture may affect one, two, or three coats only at a time.

a. Incomplete rupture of coats.—These are only observed in the post-mortem of cases who have died from blows and rupture of other organs.

Thus, a boy was admitted into Guy's in a state of collapse, having had the wheel of an omnibus pass over him. He was irritable and restless; constant vomiting of dark-coloured matter. No urine secreted. Abdomen tender. Died in nine hours. Liver ruptured in several places on under surface of right

[1] Richerand's 'Physiologie,' Paris, 1833, tom. i, p. 282.

lobe, but little effusion of blood. Mucous lining of stomach torn in shreds.

Man, received a blow on right side from shaft of dray. Brought to Guy's collapsed, with imperceptible pulse and difficulty of breathing. Rallied in two hours. Reaction, venesection. Death in eight hours. Ruptured spleen, and large stomach; quantity of blood in abdomen; ruptured peritoneal coat of stomach; two ribs fractured.

Devergie found generally five, twenty, or thirty tears in exterior coat, and principally at the lesser curvature. These were half an inch or one inch long, without separation of edges, like a clean cut. He also found corresponding tears in the mucous membrane; and he states that their direction is always from before backwards. In all his cases, death had resulted from other severe internal lesions. His statements are, however, not perfectly authoritative, as shown in the two cases we have narrated.

b. Complete rupture of coats.—Here death may ensue at once by shock or irrecoverable collapse. Much depends on the condition of the organ and its contents at the time, and the extent of the laceration.

The symptoms, if life should be prolonged beyond immediate death, will be

1. A peculiar, sudden, most acute and unremitting pain radiating from the seat of mischief; and, as has been observed by a writer, "so peculiar is the pain, that the intensity of it absorbs the whole mind of the patient, who, within an hour from the enjoyment of perfect health, expresses his serious and decided conviction that if the pain be not speedily alleviated he must die."

2. Remarkable rigidity and hardness of belly, from contraction of the abdominal muscles.

3. Pulse varies; may be natural for a time previous to peritonitis; may be slow, and may be intermitting.

4. Anxiety, collapse, rigors, and syncope.

5. Vomiting of contents, and afterwards of blood.

Termination generally fatal; may be sudden; may be from acute peritonitis, either with or without effusion of contents; may be from hæmorrhage, or rupture of vessels. There is a chance of recovery where rupture is small, stomach empty, and subsequent peritonitis local; glueing injured part to sur-

rounding tissues. This may have probably been the case in the two instances recorded under chronic gastritis.

Few cases of *ruptured stomach* are placed on record; hence we may presume its rarity. In one case death followed in three hours, and in the second in five hours. The third case lived five days; and it is a matter of probability that in this case a recovery might have been effected by judicious treatment.

CASE I.—A drunken man fell from first floor on to the pavement, striking his body. There was no external mark, and he had great tympanitis. Death in three hours. Ruptured cardiac end of stomach at the greater curvature six inches long. Escape of food and red wine into the peritoneum. (Roques, 'Soc. de Méd.,' vol. 65, p. 351.)

CASE II.—Man, admitted into hospital, abdomen having been squeezed between cart-wheel and lamp-post. Vomited several times, bringing up the meal he had taken immediately before the accident. No blood in the vomited matters. Death in five hours. Stomach torn almost completely across near the pylorus; liver and spleen also ruptured. (Erichsen, 'Surgery,' p. 321.)

CASE III.—Walter M'Farlan, æt. 11, healthy and stout; was swung round and round and kicked, then pushed down a brae, by which he rolled to the bottom of this steep sloping bank about eight feet. Immediately after had pain in the bowels, vomiting, and could take no food. He went out that afternoon to see a wedding. In the evening he took a little food but no drink, and became much worse. On the next day he became much more so, and vomited very much; symptoms gradually increased. He had salts, rhubarb, senna, castor oil, and powders given him, which were immediately vomited, and did no good; a third of a wine-glass of whiskey relieved him. On the third day he had some sweet milk and pepper, which he vomited, together with coagulated blood. On the fifth day, after taking his breakfast as heartily as usual, he suddenly expired. He took one third of a wine-glass of whiskey on the third and fourth days, which eased him; he had had no motion during the whole time.

On examination there was no external mark. At the convex part of the stomach there was a perforation of the size of a

sixpence, and near to it two pretty large spots of purplish colour, as if about to go into same state. Extensive peritonitis and plastic effusion; a considerable quantity of pus. The whole of the intestines were inflamed. (Watson on 'Homicide.')

At the trial, on the charge of manslaughter, it was argued that this condition of the stomach was due to erosion after death; but it was considered otherwise, viz., that the opening was due to rupture from violence, for the following reasons: The immediately and quickly fatal termination after the injury; the vomiting of coagulated blood; the purple spots or ecchymosis on the surface of the stomach, which must have occurred before death; and, lastly, the inflammation and plastic and purulent effusion in the peritoneum.

A counterpart to the foregoing case is the following one, in which the opening in the stomach occurred after death; and hence caution respecting post-mortem perforation by gastric juice being mistaken for laceration from injury.

Case.—Thos. H—, æt. 90, admitted into Guy's, having been run over by an omnibus. On the following morning he had emphysema over chest and abdomen, and had not recovered from the state of collapse following the accident. He died in twenty-four hours. Post-mortem twenty-four hours after. The body was that of a large, strong man. Coagulated blood was infiltrated about the scrotum and left hip. Five or six ribs were broken, piercing the pleura, and slightly lacerating the lung in two or three places. In the stomach there was a hole of the size of a threepenny-piece; at posterior part of cardiac extremity, coats thinned around it and scarcely any muceous membrane left at that part. The contents had escaped into the peritoneum. There was no peritonitis, and the perforation had evidently been produced by the action of the gastric juice.

For an able exposition of the subject, see Mr. Wilkinson King's elaborate paper on Post-mortem Gastric Solution in the 'Guy's Hospital Reports.'

Case iv.—Some five weeks back a case of sudden death was recorded in one of the weekly papers, where a person had died from ruptured stomach from a fall. The particulars were not detailed.

Remarks.—The situation of the rupture in these cases differed; in one it occupied the cardiac extremity, to the extent of six inches; in the second, the stomach was almost completely severed near the pylorus; while in the third case, the rupture was of small size, and occupied the convex part.

The symptoms detailed are meager; it is curious that in Case II no blood was found in the vomited matters. The third case shows a remarkable immunity from acute symptoms; and, notwithstanding the large quantity of purgative medicines and stimulants administered, yet he lived till the fifth day. There can be no doubt as to the correctness of the decision as to the rupture being caused by external violence. The wonder is that the boy lived so long. Perhaps some might suggest that the stomach was not totally ruptured immediately, but bruised, and its internal coats injured, and losing its vitality, separation of the slough ensued on the fifth day, with fatal results. This argument will not quite coincide with the fact of thevomiting of coagulated blood, &c. &c. As to its being a post-mortem result, it is quite out of the question, and we have only to compare it with the case annexed to it, to clear up any doubts on the matter.

B. Contusion attended with Injury to the small and large Intestines.

I. *Acute inflammation* or traumatic enteritis, cæcitis, colitis, do not differ from the ordinary idiopathic forms, and are accurately and fully described in medical works. These cases, although they generally fall under the province of the physicians, yet the surgeon should be perfectly acquainted with the symptoms, diagnosis, prognosis, and treatment.

II. *Chronic inflammation.*—The same remarks apply here likewise.

The symptoms are exceedingly obscure, and often simulating chronic peritonitis. It sometimes causes thickening and obstruction as observed in the following remarkable case, communicated to the Académie de Chirurgie, by M. Braillet, many years ago.

A man, about 65, was thrown off his horse on to the handle of his sword, and violently struck the abdomen, two fingers

off the umbilicus. He was carried some distance; had three or four bleedings, which alleviated the acute pain that he had suffered for some time. At the end of four months he had frequent vomitings with pains like colic, especially at the seat of the injured spot. Venesection, baths, emollient fomentations, and soothing drinks administered, so that he appeared to have been radically cured. Fifteen months after accident same symptoms again recurred, which made gradual progress, until he had stercoraceous vomiting. The motions were at first narrow, then lessened, until absolute constipation resulted. Many considered it to be a case of volvulus; but M. Braillet persisted in thinking that the intestine had become contracted, as a consecutive effect of the contusion which he had received in his fall. The patient was made to take an ounce of metallic mercury three or four times, and some leaden balls. He died several days after, with the ordinary results of strangulated bowel. It had been proposed during the latter part of the patient's life to cut down upon the seat of injury and open the abdomen. The opening of the body immediately displayed the seat of disease. The jejunum was contracted to an extent of six inches, and was much inflamed. The pouch which had been formed above the stricture, contained the mercury and balls, and was exactly opposite the seat of injury.

III. *Injury and contusion of the bowel,* with subsequent sloughing and ulceration, &c.

The details accompanying the cases will sufficiently explain the condition, symptoms, and results. They comprise three varieties.

First variety.—Case of W. J—, a soldier at St. Sebastian. A splinter of shell struck the abdomen, causing a bruise of the integument. On the sixth day, sloughing of the integument took place, and the fæces passed through the opening; an artificial anus was thus produced. By cleanliness and pressure on the opening, the fæces resumed their natural course on the third month. In six months the opening entirely closed and cicatrized over. (Hennen's 'Milit. Surgery,' p. 411.)

Here we have a successful issue of bruised bowel and reparative proceedings on the part of nature's own efforts.

Second variety.—Severe injury to the Abdomen, terminating fatally.—This is an instance of prolonged attempts at repair for three months, and ultimate failure, sloughing and ulceration of the gut into the peritoneal cavity.

Thomas Kay, æt. 24, received an injury on 25th of March, 1828, from the wheel of a loaded cart passing over the abdomen, and was carried to the Royal Infirmary, Edinburgh, where, after the urine had been drawn off, he was bled, fomented, and ordered a purgative injection. On the third day, after he had been bled by leeches on the abdomen, the urine, which had been previously retained, began to pass naturally. The pain was at this time in the left hypochondriac region. Bleedings from the arms and by leeches, and anodyne and turpentine injections were the remedies employed, and, as it appears from the report, with manifest relief. In about a week after the accident, dysenteric symptoms came on, with rigors, sweating, occasional vomiting, pain in the abdomen, particularly in the left iliac fossa, and dark fetid stools. These symptoms were combated by leeches, Dover's powder, castor oil, pills of calomel, antimony and opium, with fetid and anodyne injections. The pulse was reduced from 110 to 88; the tongue rendered cleaner; the thirst lessened; the character of the stools improved; and the patient discharged at the end of the third week, relieved.

At the end of April he became an out-patient of the Old Dispensary. He complained chiefly of severe griping pains of the epigastrium, with considerable flatulent distension in that region, of dysuria, and of thirst, but not of costiveness, the stools being rather liquid, though small in quantity. A draught of castor oil and laudanum, followed next day by salts and senna, speedily relieved him for the time; but a recurrence of similar symptoms compelled him again to take refuge in the Infirmary, in which he was again relieved, by measures similar to those previously employed. After the lapse of a fortnight he left the hospital; and on the 19th of June again applied to the Dispensary, having been seized two days previously with œdematous swelling and pain of the left lower extremity, from the thigh to the ankle. He had at the same time considerable dysuria, but did not complain of tormina. He was bled and freely cupped, and by this treatment the swelling

and pain of the limb were much diminished; but he was suddenly seized, four days after the cupping, at half-past 1 p.m., with acute pain in the abdomen; he died at half-past 2 the the following morning, his intellects remaining perfect till an hour before death, when he became a little incoherent and violent.

Post mortem—Adhesions were found between the turns of the small intestines, uniting the greater part of them into one mass, at the lower part of which, in the right hypogastric region, there was an opening through which fluid fæces escaped. On separating some of the neighbouring adhesions, it was found that the small intestine was at this part ulcerated through nearly its entire circumference. That part of the small intestine which was between the duodenum and the opening was very much enlarged, in some parts to nearly the size of the colon, and distended with fluid feculent matters. Very little fæces were actually effused, but some slight traces of increased vascularity were discoverable on several points of the peritoneal surface. ('Edin. Med. and Surg. Journ.,' vol. xliv, p. 281.)

The *third variety of cases* were followed by *loss of vitality, sloughing,* and casting off of portions of cylinder by natural process, and evacuation thereof per rectum.

Although of rare occurrence, still cases of this kind have been published. We shall make extracts of those resulting from injury, as forming an appropriate addition to this communication. They are good specimens of the vis medicatrix naturæ.

Case i.—Soldier, æt. 40, having been thrown down and trampled upon by an adversary, complained for some weeks of most excruciating pains in the abdomen, and frequently experienced during that time most obstinate constipation. These symptoms, along with continued efforts to vomit, gave reason to apprehend the supervention of iliac passion. The pains were not alleviated by the remedies employed, and the patient appeared in a desperate condition, when suddenly diarrhœa came on; and he passed large quantities of mucous matter, mixed with blood and sanies. This was again succeeded by obstinate constipation, and he felt that some foreign body

was lodged in the rectum, which with his utmost exertion he was unable to evacuate. At last, when straining at stool, he perceived a small portion of substance protruding from the rectum, and laying hold of it, he succeeded, with the aid of the natural efforts, in extracting it; a considerable quantity of blood and matter being discharged at the same time. On examination, this substance was found to consist of a portion of intestinal tube, more than a span in length, both the extremities of which showed evident marks of inflammation and gangrene. A portion of omentum adhered to it externally. On the internal surface, at one extremity, was found the valve of Baukin (valvula coli), showing the part of the canal, from which this portion of intestine had been separated. For the first three days nothing was passed from the bowels but some purulent matter; but on the 4th, natural dejections were obtained. The patient gradually recovered, and resumed his military service. ('Joh. Peter Albrecht, de Intest. et Ephem. Med. Phys. German, Decur. iij, An. iij, Obs. cxxix.' p. 227.)

Case ii.—A man, æt. 40, over whose body the wheel of a stage-coach had passed, complained, when seen soon after the accident, of great pain in the abdomen, across which, between the navel and pubes, was the mark of the wheel. In the course of a fortnight he was able to walk about a little. He then complained of a weight at the navel. On the 17th day after the accident in the evening, whilst sitting by the fire, he was seized with a feeling of general debility, which continued for ten minutes, and returned the next night. On the following morning he voided per anum full fourteen inches of his intestines, being apparently a portion of the ileum, with a part of the mesentery adhering to it; after which he had a lax stool, more in quantity than he had got quit of at any one time since the accident. At the end of two or three weeks a tumour appeared before the navel, which burst in a few weeks, and discharged a large quantity of yellowish matter, having a faint smell of fæces. Subsequently three or four other small tumours appeared at different times and broke, leaving five orifices, two of which continued open several years afterwards, with constant discharge

of yellowish or brownish matter, and frequent emission of fetid wind. This patient gradually recovered, so as to enjoy a tolerable state of health. (By Mr. John Bower, 'Annals of Medicine for 1802,' p. 345. Prep. in Anat. Museum of University of Edinb. I, iii.)

Case iii.—A boy, æt. 12; complained of wandering colic-pains, which he imputed to blows received on the belly from some of his companions. These pains returned frequently, with diarrhœa, and sometimes bloody stools, for nearly a year. At the end of that time, on being seen, he was much emaciated, had a quick pulse, and was so weak as to be confined to bed. Two weeks after this he passed at stool a livid membranous substance, tubular, and when distended with air, thirteen inches long, having the mesentery attached all along its concave side. Besides this large portion, there were several shreds and smaller pieces passed by the patient, notwithstanding which, there were afterwards seen among his fæces, skins of potatoes which he had eat after these parts of the intestine came away, so that they had not produced any discontinuity in the alimentary canal. The symptoms continuing, the boy died in six weeks.

On dissection, the folds of the intestine and omentum were all glued together by a fatty curdy matter. Within four inches of the valve of the colon, the ileum, formed into the usual curve by the mesentery, suddenly rose perpendicularly, and at that point it was much contracted, and had the appearance of a cicatrix. When the intestine was opened, this contracted part of it was found much thicker and harder than it was anywhere else, especially on one side, where it stood so far into the cavity as to leave a very small passage for the aliment. Along this contracted part the mesentery was firm and thick. After this the intestine became of a natural enough form. ('Remarks on Procidentia Ani, Intussuscep. &c.,' by Dr. A. Monro. Primus, 'Phys. and Lit. Essays,' ij, p. 353. 'Case communicated by Dr. Cullen.' Prep. in Anat. Museum Univ. of Edinb.)

IV.—*Ruptured Coats of Intestines.*

a. Partial—of one of coats, either the serous or mucous, not sufficiently distinctive to require special notice.

b. Complete rupture of coats will be considered as it affects the different portions of the intestinal tube, taking those affecting the small intestines and their subdivisions; then the large intestines and their component parts. The general symptoms and treatment of ruptured bowel have been already alluded to, and only here again referred to, as to the question of there being any peculiarity or speciality in the part injured.

A. CASES OF RUPTURE OF THE DUODENUM.

CASE I.—Elizabeth H—, æt. 4; wheel passed over abdomen. Collapse; extreme restlessness and nausea; no tenderness. Pulse quick and scarcely perceptible; pale, sunken features; exhaustion. Death in five hours. Small rent in descending portion of duodenum; cherry-stones mixed with alimentary matter effused into abdomen. Slight rupture of spleen, but very little blood extravasated. (Ellis, 'Lancet,' 1835, p. 19.)

CASE II.—Boy, æt. 13; received blow on abdomen, walked a mile with but little assistance. Death in thirteen hours. Duodenum ruptured completely across. (Taylor, 'Med. Jurisp.')

CASE III.—George W—, æt. 20; wheel of carriage passed over abdomen. Great suffering; intense pain on least movement; dark-coloured vomiting. Death in eighteen hours. Longitudinal rent, one inch long, at convex part of first turn of duodenum. Small quantity of effused matter. ('Edin. Med. and Surg. Journ.' vol. 39, p. 323.)

CASE IV.—Labourer, æt. 32; fell across gunwale of barge. Death in three days. Ruptured duodenum. ('Lancet,' 1848, p. 701.)

Thus then we have only been enabled to collect the above four cases, although some others may be on record, still it shows rarity of rupture of this portion of intestine. Undoubtedly it is the most fixed portion of the canal, and thus exposed to a greater liability to lesion; yet its position renders it so far safe, as its first portion is protected by the liver, and its third portion in the folds of the transverse meso-colon. In the

four cases, all of which were fatal, one died in five hours, one in thirteen hours, one in eighteen hours, and one lived three days. It seems extraordinary, that a boy, with rupture of the duodenum completely across, should walk a mile after the accident.

The first case evidently died of collapse and extreme nervous prostration; although the rent was small, it occurred in the middle portion of the duodenum, and allowed the escape of cherry-stones into the abdomen. The ruptured spleen was concomitant, and had evidently little to do with the death.

In Case III the rent was vertical, and one inch long at the first portion of the gut, yet only a small quantity of effusion took place, but sufficient to induce fatal peritonitis.

B. CASES OF RUPTURED JEJUNUM.

This portion of the canal is considered to be the most frequently ruptured, more especially the upper part, on account of its fixed position with the duodenum at the left side of vertebral column.

CASE I.—Strong, robust boy, æt. 2; had been largely fed when he fell from his chair. Violent pain ensued and vomiting, although little was brought up; three hours after, excruciating torture, incessant retching and evacuation of mucus; belly tympanitic and painful on least pressure; the symptoms were considered to arise from metallic poison. An emetic was administered, which aggravated the symptoms. Ordered calomel, clysters, warm bath and fomentations, and was bled. He died in the course of a few hours. The upper part of the jejunum was completely torn from the duodenum; and the torn ends separated nearly one inch. Stomach and small intestines quite empty, and contracted. A quart of fluid, chiefly broth, in peritoneum. Active peritonitis. Much gas escaped on opening the abdomen, which was distended and tympanitic. ('Dublin H. Rep.' vol. i, p. 311.)

Here we have an instance of rapid fatality from complete rupture, in consequence of the distended state after a large meal. It seems extraordinary that the case should have been mistaken for metallic poisoning; the exhibition of an emetic was an unfortunate proceeding.

Case ii.—An ostler, æt. 36; received a kick from a horse on abdomen. Had only had some porter previously. He fainted immediately, and on reaction had pain in abdomen and vomiting. He was bled and purged. Seven hours after in excruciating pain, with constant vomiting; pale, anxious, and shrunken features; pulse 140, feeble; abdomen flat and rigid; legs drawn up; unable to bear weight of clothes; no urine passed, requiring the use of the catheter, drawing off two pints of high-coloured urine; leeches, fomentation, emollient enemata; exhaustion, and death in eighteen hours. Upper portion of jejunum ruptured half across; oval opening and everted mucous membrane; ecchymosis on arch of colon; serous fluid, mixed with bile and contents of intestine in abdomen; extensive peritonitis; sixteen ounces of extravasated blood between layers of mesocolon, from ruptured mesenteric vessels. ('Dublin H. Reports,' vol. v, p. 296.)

Case iii.—George P—, æt. 45; wheel of light cart passed over abdomen. Collapse, vomiting, and much pain; blood in vomited matters and in stools; peritonitis; slight purgatives. Death in two days. No external mark; jejunum little below level of umbilicus completely severed transversely and mesentery fissured; lower end one and a half inches apart, and laid glued between other convolutions. Both ends poured out their contents into separate collections; intense peritonitis; gas escaped on opening abdomen (six hours after death), as also bloody, filmy and fecal fluid. ('Guy's H. Rep.,' Series II, vol. ii, p. 479.)

Case iv.—Irishman, æt. 40, of spare habit; a stone, 8 cwt., fell on a projecting body, and thence obliquely striking him on abdomen, knocking him down. He speedily recovered; jumped up and ran across the road. Soon became faint, and was admitted into hospital half an hour after; collapsed, but quite conscious; countenance pale and lips exsanguine; much pain in abdomen, and especially in pubic region. Had urinated ten minutes before accident. No tumefaction observed; but integuments slightly ecchymosed. He laid on right side, with legs bent; ordered warm clothing; hot bottles to feet. Five hours after, abdomen distended; excruciating pain; pulse

feeble; thirst. Fomentation; thirty drops of Tr. Opii, but it was instantly rejected. Death in thirty-one hours. Rupture of jejunum, three hands' breadth from termination of duodenum, rent capable of admitting little finger. Considerable quantity of brownish-coloured fluid, and portions of alimentary matter in abdomen; extensive peritonitis; small intestines glued together; duodenum filled with half-digested food. (St. Thomas's Hospital, 'Lancet,' 1825, vol. ix, p. 428.)

Case v.—William Hart, æt. 15; fell off mast of ship into hold, across a bar of iron. Great pain and tenderness, especially on each side of navel. Collapse; countenance particularly anxious, lips pallid, and surface cold; vomiting. Fomentation and venesection. Was better in the evening, and took milk and tea. On following day restlessness and peritonitis; countenance distressed in a marked degree; exquisite pain and tenderness on pressure; breathing difficult; diaphragm almost motionless; inspiration short and rapid. Thirty leeches to abdomen; 3 grs. of calomel, and $\frac{1}{3}$ gr. of opium every four hours; Enema Coloc. Death twenty-eight hours after admission. Opening size of shilling, at commencement of jejunum; omentum adhering to it, so that nature had began a reparative process. Intense peritonitis and agglutination of the intestines. ('Lancet,' vol. i, p. 235.)

Case vi.—Young man, æt. 20; blow on abdomen from brick thrown at short distance. No external mark. Death in forty-two hours. Ruptured jejunum in upper part, three quarters of an inch long. Escape of contents. Peritonitis and plastic effusion. (Dr. Gross, 'Pathol. Anatomy.')

Case vii.—Coachman, æt. 22; kick from horse, on left side, between ribs and ilium. No external mark. Death in thirty hours. Ruptured jejunum, eighteen inches from duodenum; two rents, one about a third of its calibre, and the other nearly entirely across. Two quarts of fluid and feculent matter in abdomen. Peritonitis and agglutination of intestines. (Dr. Drake, 'Med.-Chir. Rev.,' vol. xxiv, p. 142.)

Case viii.—Jane C—, æt. 9; blow from stone upon the

abdomen, a little below the navel. The stone was of considerable size, and thrown by a man at another. Immediately great pain and sense of burning. Collapse; frequent vomiting. Death in twenty-one hours. Ruptured jejunum, two feet from stomach, half an inch in extent, and exactly opposite seat of blow; a small portion of the coat, half an inch in diameter, was almost completely detached from side of intestinal tube; this torn portion, when replaced, closed up the opening like a valve, and an adherent part of omentum also seemed to assist in forming a covering to aperture, so as to repair breach. Peritonitis; agglutination of intestines; some of contents of bowel effused in cavity. (Watson on 'Homicide,' p. 187.)

Case ix.—S. H—, kick from horse in upper part of hypogastrium. Peritonitis and great pain. Warm bath; blisters; large bleedings with relief. Death in twenty-two hours and a half. Circular hole in jejunum; effusion of fecal matter; bladder empty and contracted. (Hennen, p. 101.)

Case x.—Middle aged man; received a kick from a horse just before dinner time. Seen three hours after; acute pain a little below navel, the seat of injury; no mark; collapse; knees drawn up; urine clear; nausea and thirst. Opium and Hyd. c. Creta; spirits of turpentine sprinkled on flannel applied to abdomen. On following day rallied, and absence of all urgent symptoms, when sudden vomiting and intense burning pain, extending over whole abdomen, occurred; acute peritonitis. Leeches; Opii, gr. j; Cal. gr. $\frac{1}{2}$, every hour. Death in thirty-six hours. Ruptured jejunum at junction of middle and lower third, size of a fourpenny piece, surrounding lymph; effusion of liquid feculent matter; peritonitis and plastic lymph. (Dr. M'Cormack, 'Lancet,' 1852, vol. ii, p. 78.)

Case xi.—Man fighting with another, received a blow in abdomen. No mark. Death some hours after. Ruptured jejunum; extravasation; peritonitis. (Henke, 'Zeitschrift.')

Case xii.—A debauched drunken man, æt. 60, knocked down by cab, which ran over the right leg, producing fractured fibula. Complained at times of slight bellyache, but not in a manner to excite attention. Ordered by house-surgeon several

doses of aperient medicine, none of which operated. On the evening of the fourth day the belly became somewhat tender, and swollen with flatus; tongue foul, and pulse undisturbed. Ordered an enema, and a mustard poultice to the abdomen; had three copious evacuations during the night; and on the morning of the fifth day stercoraceous vomiting took place; abdomen generally tender and tight, and pulse intermitting. Leeches applied; calomel and opium given internally, and stimulants used as often as the state of the pulse seemed to require it. Vomiting stayed for eighteen hours by the opium; but death ensued on the night of the sixth. Ruptured jejunum; considerable fecal effusion in left lumbar and hypochondriac regions, circumscribed by recent peritoneal adhesions; the mesentery near the termination of the ileum had also been torn from its attachment to that intestine for an extent of four inches; no blood extravasated. ('Pathol. Transact.,' vol. iv, p. 151.)

Case xiii.—James P—, æt. 37; fell from market-cart, and wheel passed over his body; no collapse; constant vomiting. Took large quantities of ice. Death in twenty-four hours. No external mark. Jejunum completely severed from the duodenum; ends four inches apart; acute peritonitis; three to four pints of thin, pink-coloured fluid in abdomen, probably the iced water taken into the stomach. (Guy's Hospital.)

Case xiv.—Man kicked in the abdomen. Fatal in forty-eight hours. Jejunum ruptured; extravasation of contents; peritonitis. (Guy's Hospital Museum, Prep. 1851^{86}.)

Remarks.—We have thus given a summary detail of fourteen cases of ruptured jejunum, of which no less than seven cases, viz., i, ii, iii, iv, v, vi, and xiii, had the rent in the upper part of the canal, close to the duodenum; in one, Case x, the rent was at the junction of the middle with the lower third; in one, Case xii, it was in the lower part; and in the remainder, the exact seat is not stated.

We shall now consider the extent of lesion, and—

1st, *where the bowel is ruptured entirely across.*—Cases i, iii, and xiii present almost similar injuries to the intestine; in all three, the jejunum had been forcibly torn away from the

duodenum; there is no doubt that the junction of the duodenum with the jejunum is a fixed point, and any pressure upon the abdomen causing a dragging downwards of the bowels, must tend to put this part on the stretch, and in some instances, as in the cases quoted, cause complete separation. The cause in the first was a fall from a chair while the stomach and duodenum were loaded; and in Cases III and XIII a light cart-wheel passed over. One lived a few hours, another twenty-four hours, and the third two days; in two of these death was probably hastened by the treatment. Case XIII gave no evidence at first of any mortal injury; there was no collapse, and the case was considered of but little moment. It offers an instance of the incautious and immoderate use of ice, given internally.

2d, *where ruptured three quarters or half across* (CASES II, VI, VII).—In two produced by kick of horse, and in one by blow of a brick. Death resulted in eighteen, thirty, and forty-two hours; in all there was escape of the contents, and intense peritonitis.

3d, *where ruptured less than half of calibre* (Cases IV, V, VIII, IX, X).—Caused in two cases by blow of stone, in two by kick of horse, and in one by fall off mast on to a bar of iron. Death in twenty-one, twenty-two and a half, twenty-eight, thirty-one, and thirty-six hours. In Cases V and VIII nature had attempted an effort at repair, by stopping up the gap by omentum, but it was too late; and it is not at all unlikely she was interfered with by art; certainly Case V was better until the patient took milk and tea, when effusion and peritonitis rapidly followed. In Case IV the man ran across the road after the accident. Case X, on the following day, was free from all urgent symptoms, when sudden vomiting, a fatal effusion, and peritonitis resulted; this warns us not to be too sanguine, and always to be cautious in keeping the patient at rest. In two, Cases XI and XII, the size of the rent is not stated; one of these is remarkable for the attempts at repair.

C. CASES OF RUPTURED ILEUM.

These we have placed in a tabulated form, consisting of sixteen cases, to which are added six other cases, in which the portion of the small intestine injured is not stated.

Cases of Ruptured Ileum.

	Cause.	Primary effects.	Secondary effects.	Treatment.	Post-mortem appearances.	Death.	Reference.
1. Richard A—, æt. 34.	Kick from horse in hypogastrium.	Complete collapse; vomiting; copious stools, but no blood.	Peritonitis.	......	Small intestines in pelvis; rupture size of a shilling; effusion of fæces; general peritonitis.	Eight days	S. Cooper, Lancet, 1836, p. 191.
2. Man	Ditto.	No external mark.	Ditto.	......	Lower third of ileum torn across.	Thirty hours	Dr. Williamson, of Leith.
3. Andrew S—	Kick by man.	Ditto.	Ditto.	......	Ruptured ileum, half an inch; escape of feculent matter, and lumbrici in abdomen; severe peritonitis.	Twenty-four hours.	Watson on Homicide, p. 187.
4. W. F—, æt. 37, hussar.	Kick by horse, above pubes.	Excessive pain and great tension; vomiting.	......	Fomentation; V.S.; salts and senna every two hours.	Laceration of ileum; fecal effusion.	Forty-eight hours.	Guthrie's Commentaries, p. 513.
5. Man, æt. 35.	Ditto.	Cruel pains, tension, and vomiting; difficult breathing; no mark.	......	......	Ileum completely ruptured, and partly the mesentery; much blood effused.	Death.	Morgagni, lett. 34, art. 14.
6. Carman, æt. 32.	Wheel passed over body.	Collapse; reaction; great pain, and sense of fulness of stomach.	Intense peritonitis; passed quart of dark-coloured urine, but no blood.	Opium.	Longitudinal rent in ileum, one and a half inches; no escape of contents; peritonitis and plastic effusion.	Twenty-four hours.	Ward, Pathol. Trans., vol. ii, p. 202.

	Cause.	Primary effects.	Secondary effects.	Treatment.	Post-mortem appearances.	Death.	Reference.
7. Boy, æt. 15	Wheel of loaded waggon passed him.	Partial collapse; no vomiting; constant pain.	Became collapsed and blanched; lay on left side; bloody urine drawn off.	......	Ruptured ileum in three places; intestinal worms in abdominal cavity; right kidney and vein ruptured, much effusion of blood.	Twelve hours.	Travers, Lancet, vol. i, p. 588.
8. John T—, æt. 36.	Fell from mast, fifty feet; intercepted in descent.	Partial collapse; no particular pain.	Peritonitis complicated with cerebral and spinal injury.	Calomel; C.C. nuchæ.	Two small ruptures in ileum, and slight effusion of fæces, circumscribed; fractured skull and lacerated brain.	Twenty-four hours, sudden.	Guy's Hospital Reports, Oct., 1844, p. 480.
9. H. D—, æt. 34.	Handle of truck driven against right hypochondrium.	No external mark; continued vomiting; abdomen painful.	Constipation.	V.S. and actively purged, and then sent to hospital; local depletion: calomel and opium; saline purges.	Rent in upper part of ileum, size of sixpence; fecal extravasation; peritonitis.	Thirty hours	Ditto, p. 477.
10. Drayman, æt. 30.	Barrel fell on loins, knocking him down	Collapse; pain at lower part of abdomen; retention of urine.	Peritonitis sudden and rapid on following day.	Fomentation; cathartecism; gentle stimulants.	Small rent in ileum; slight extravasation; lacerated omentum; general peritonitis.	Twenty-four hours.	Ditto, p. 478.
11. Henry E—, æt. 11.	Wheel passed over abdomen.	No collapse; no external mark.	Peritonitis.	......	Ruptured ileum, size of shilling; also rupture of mesenteric vein; and effusion of blood in mesentery and abdomen; peritonitis.	Eighteen hours.	Guy's Hospital, Aug., 1855.

12. Thomas T—, æt. 10.	While at play, fell on curb-stone, and boy fell on him.	Immediate pain; went home, when leeches applied, and then sent to hospital; no collapse; no external mark.	Severe peritonitis.	Leeches, opium, ice, small and frequent quantities of beef tea, enemata.	Upper part of ileum perforated size of quill; large and circumscribed fecal abcess; reparative peritonitis; early conditions of pyæmia; superficial suppuration of liver, and pyæmic pneumonia.	Sixteen days	Guy's Hospital, 1856, (Mr. Poland's case)
13. Gentleman, æt. 61.	Thrown from gig on ground	Able to walk immediately after, and did not appear much hurt; in few minutes violent pain and collapse; no mark.	Continued and unintermitting pain at umbilicus; no restlessness; slight tympanitis and occasional bilious vomiting; thirst and constipation.	......	Irregular opening, size of quill, in ileum, two and a half feet from cæcal valve; feculent effusion; intense peritonitis.	Thirty-six hours.	Dr. Gross, Path. Anat.
14. J. A—, æt. 45.	While intoxicated, fell over wall, five feet high, striking abdomen on piece of wood.	Prostration, severe pain, and vomiting.	......	......	Ruptured ileum; peritonitis and inflammatory effusion.	Five hours.	Watson on Homicide, p. 77.
15. Boy, æt. 8...	Cart wheel passed over belly.	Collape, great pain, and sense of burning.	......	......	Intestinal canal torn across in six or seven places.	Few hours.	Ditto.
16. J. H—, æt. 36.	While carrying sack of flour over plank, fell on left side on edge thereof.	Collapse; slight bruise in left loin; case considered slight.	Pallid; no complaint; on following day, peritonitis and tympanitis.	Purgatives; enemata.	Ruptured ileum, size of sixpence; slight fæcal effusion; peritonitis; plastic agglutination.	Two days.	Guy's Hospital (Prep.1851[85]).

CASES OF RUPTURED SMALL INTESTINES—PORTION OF BOWEL INJURED NOT STATED, PROBABLY ILEUM.

	Cause.	Primary effects.	Secondary effects.	Treatment.	Post-mortem appearances.	Death.	Reference.
17. Young man	Kick from horse.	Vomiting and tympanitis.	Peritonitis.	......	Lacerated small intestine; effusion of contents.	Five days.	Cooper's Dict., p. 3.
18. M. H—, æt. 22.	Wheel of carriage passed over abdomen.	No uneasiness; tympanitis.	Progressed favorably, and was almost convalescent after being two months in hospital; sudden hæmoptysis and death.	V.S.; leeches; careful diet.	Ruptured intestine and omentum, forming a plug, projecting into bowel one third of an inch.	Two months	Jobert.
19. Boy	Struck in belly by piece of wadding from gun, and then fell from tree.	Considerable collapse.	Retching; swelling and tension of abdomen; peritonitis.	......	Ruptured small intestine; considerable effusion.	Death.	Guthrie.
20. Child just able to walk.	Tossed up in air, and in descent caught by thumb in crutch.	Great pain and swelling.	......	......	Ruptured small intestine; fecal effusion.	Death.	Ditto.
21. J. H—, coachman.	Fell with horse, latter upon him.	General languor, anxiety, and depression; no external mark.	Peritonitis on following day.	......	Complete rupture of small intestines, as if cut by scalpel; bladder extensively lacerated.	Two days.	Ditto.
22. J. H—, æt. 40.	Crushed against a waggon by mass of earth.	......	......	......	Ruptured small intestine in iliac region; no effusion; peritoneum and transversalis and internal oblique muscles torn and omentum protruding.	Thirteen hours.	University College Hospital (Lancet, 1835, p. 541).

Remarks.—Respecting the causes, these are various. In five it resulted from the kick of a horse; in one from the kick of a man; in five from wheel passing over abdomen; in others from fall on hard substances, &c.

As regards the extent of the lesion—

1st, *where completely ruptured across* (Cases II, V, XV, and XXI).—In two it was produced by the kick of horse. There was no external mark in any; there was much suffering, and death occurred in one case in a few hours, in another thirty hours, and in the other two on second day.

2d, *where rupture three quarters or half across* (Cases III, VI). Both died in twenty-four hours, and had extensive peritonitis; in one there was no escape of the contents, whereas in the other there was fecal effusion and escape of lumbrici into abdominal cavity.

3d, *where rupture less than half of calibre* (Cases I, VIII, IX, X, XI, XII, XIII, XVI, XVIII), produced by every possible variety of injury. Case XI lived only eighteen hours, being complicated with ruptured mesenteric vein, and having not only effused fecal matter, but also extravasated blood in the abdominal cavity. Cases VIII and X died in twenty-four hours, both of which were also complicated, one with fractured skull and lacerated brain, the other with lacerated omentum. Case IX died in thirty hours; he had been actively purged before he was sent to the hospital, and even then calomel and opium, with saline purges, were afterwards administered. Case XIII lived thirty-six hours; he was able to walk after the accident, but soon succumbed to the effects thereof, for effusion rapidly ensued, inducing immediate collapse and a violent, continued, unremitting pain, followed shortly by peritonitis. Case XVI lived two days. He rallied on the day following the accident, and made no complaint; however, purgatives were administered; extravasation and peritonitis soon carried him off. Case I lived over a period of seven to eight days; the rent was of the size of a shilling; there was fecal effusion and peritonitis; no other detail given. Case XII occurred in a boy, æt. 10, in whom the upper part of the ileum was perforated, of size of goose-quill; he had no collapse, but peritonitis soon set in. It was prognosticated that he had ruptured bowel, and for the first week he was treated with solid opium, and

allowed to take nothing by mouth, with the exception of a cautious and moderate use of ice to suck. He had injections of beef tea and nourishing fluids. Leeches were freely used to the abdomen. On the eighth and following days he was allowed the strong essence of beef, jellies, &c., in small quantities and at repeated intervals. It was hoped that the child would have recovered, but symptoms of pyæmia set in, and he died on the sixteenth day. There was found a circumscribed fecal abscess and reparative peritonitis; all active inflammation having entirely subsided. There was evidence of early pyæmia; very superficial suppuration of the liver, and pyæmic pneumonia. The case is instructive, as showing that life may be prolonged by keeping the bowel quiet, and allowing no irritating purgative to be administered. Case XVII is a most unique case of recovery from ruptured bowel, where the omentum passed into the rent to the extent of half an inch, and there formed a perfect plug; the case progressed favorably under judicious treatment and most careful diet. The patient unfortunately died of sudden hæmoptysis, two months after, when the above conditions were found.

In the remaining seven cases the size of the rent is not stated, viz., Cases, IV, VII, XIV, XVII, XIX, XX, and XXII. Case XIV lived only six hours; he was intoxicated at the time of the accident, and in all probability some of the liquor escaped into abdominal cavity, as there was stated to be much effusion and peritonitis. Case VII lived twelve hours, but was complicated with ruptured kidney and renal vein, and large extravasation of blood. Case XXII also lived only thirteen hours; but here there was no effusion, but severe laceration of the peritoneum and abdominal muscles. Case IV died in forty-eight hours; and no wonder, when he had salts and senna every two hours. Case XVII lived five days, succumbing to peritonitis. Cases XIX and XX are only peculiar as regards the cause of the injury. In one, a boy who was on a tree, and was struck on the abdomen by the wadding of a gun, when he fell to the ground. In all probability the rupture was caused by the wadding, yet one cannot divest oneself of the question raised, as to whether it might not have been produced by the fall; it is interesting in a medico-legal point of view. The other was that of a child just able to walk, who

was being danced up in the air by his father, and in a descent was unfortunately caught in the crutch on the top of the father's thumb, rupturing the intestine, and causing fatal effusion.

D. CASES OF RUPTURED BOWEL OCCURRING IN PERSONS THE SUBJECT OF HERNIA, BUT INDEPENDENT OF ANY HERNIAL MISCHIEF.

Under this class we have a series of cases, which demand the utmost attention and circumspection on behalf of the practical surgeon, not only as to the question of diagnosis, but as to the treatment to be adopted.

Case i.—Man received kick from a mule on the abdomen, at the same time having a reducible hernia down. Severe colic and vomiting ensued. It was supposed that he had strangulated bowel, and was operated on. Death, however, resulted. On examination the small intestines were found completely torn across. (S. Cooper, 'Dictionary,' p. 3.)

Case ii.—J. A—, æt. 46, subject to a reducible inguinal hernia; was knocked down by a horse and chaise, and fell on face; wheel passing over leg. Walked to bed, and undressed himself; slight collapse; no external mark; hernia returned; peritonitis in evening; anxiety and depression; hiccup; vomiting. Death in sixteen hours (twenty-four hours.) Ileum completely ruptured about two feet from cæcum, and about three and a half inches therefrom a second rupture of the gut through two thirds of calibre; there was also one and a half inch of mesentery torn; three quarts of fluid blood in abdomen; general peritonitis. (Guy's Hospital Museum, Prep. 1851[84].)

Case iii.—Mrs. M'Court, middle aged; was the subject of a femoral hernia on the left side. Some years previously it had been strangulated, and was operated on by Liston; but, in consequence of the great dilatation of the parts by the knife, the hernia afterwards occupied the labium. Was struck by husband on head, face, and abdomen, which was followed by great pain in abdomen. Admitted into the infirmary, and

the femoral hernia on left side easily reduced. There was an external mark on the right side, near the upper part of the ilium. Intense pain; collapse. Death in twelve hours. Small intestine three feet from stomach nearly torn across, and exactly opposite seat of blow. Peritonitis and plastic effusion. ('Watson on Homicide,' p. 77, *et seq.*)

These three cases are exceedingly interesting, and form a connecting link between the foregoing set of cases, and the class of injuries which we shall next consider.

In Cases I and II they were men who were the subject of reducible inguinal hernia. Case I had a kick in the abdomen, when severe colic and vomiting set in; and as the hernia was down at the time, and the man had all the symptoms of strangulated hernia, he was very judiciously operated upon, and more especially as the hernia might have been the seat of injury. Death, however, took place, and it was found that the bowel had been completely torn across. In Case II the man was knocked down by a horse and chaise, and the wheel passed over the leg. He walked to his bed and undressed himself; the hernia was returned readily, and nothing more thought of the case. In the evening, however, peritonitis and symptoms of ruptured bowel set in, and he died within twenty-four hours of the accident. Although the case is recorded as one of ruptured bowel independent of hernia, it is questionable, in this case, whether the rupture did not take place in the sac itself, for there were two rents in the ileum, one completely through the gut about two feet from cæcum, and the other three and a half inches therefrom, and through two thirds of bowel, being almost the exact portions that would suffer at the neck of a hernial sac, where a coil of intestine has been down. Again, while the hernia was down he walked to the bed and undressed himself; the hernia was then returned, and fatal symptoms soon set in. This latter fact, however, is no great evidence, for in several of the foregoing cases we find similar immunity from symptoms for several hours;—thus, in the case of ruptured duodenum completely across, the patient walked a mile. We should have preferred placing the case in the next series of injuries.

CASE III appears almost the counterpart of the foregoing, and was the subject of investigation in a court of law. She was afflicted with a femoral hernia, which often occupied the labium; and was struck by her husband on the abdomen, and died in twelve hours. The husband was convicted of having caused her death. The defence set up was—1st, that the rupture occurred in the hernial sac, and that the rent in the bowel was caused by the efforts of the surgeon in reducing the hernia; and 2dly, supposing this not to have been the case, that the rupture was spontaneous and accidental from the giving way of a diseased bowel. The arguments against these theories were considered conclusive, and are well summed up by Watson.

1. The pain came on immediately after the blow, and before the reduction of the hernia.

2. The ruptured bowel was at a considerable distance from the sac.

3. No inflammation or fecal matter in the sac.

4. Distinct external mark, opposite to where the ruptured intestine lay.

4. No appearance of ulceration of the mucous membrane.

E. CONTUSIONS OF SMALL INTESTINE WHILE IN THE HERNIAL SAC.

This accident has been already the subject of a memoir by Aston Key, in an early number of the 'Guy's Reports.' He has detailed four cases, and we have collected a few more, and placed the whole in the annexed table.

The results of this injury may cause three different varieties of effects: 1st. *Inflammation of the bowel* in the sac, which may rapidly pass into a state of strangulation, and require operative measures. 2d. *Loss of vitality* of a portion of the gut, followed by sloughing and the formation of an artificial anus. 3d. *Rupture of the coats* of the bowel. To this latter we shall more especially direct attention.

Cases of Blows on Hernial Sac, with ruptured Intestine in Sac.

	Cause.	Primary effects.	Secondary effects.	Treatment.	Post-mortem appearances.	Reference.
1. Man, with large scrotal hernia.	Fall from ladder, and struck hernia.	Violent pain and tension.	......	......	Death in four hours; ileum in sac, ruptured.	Sir A. Cooper, Hernia.
2. Middle aged man, with scrotal hernia.	Pushed by the pole of a carriage.	Extreme collapse, like dying; vomiting; pains over whole abdomen.	Contents were returned, but swelling in scrotum same size.	Hernia returned.	Death in three days; laceration of ileum and mesentery to extent of five inches; blood in sac, and three quarts of blood in abdomen.	Ditto.
3. Serjeson, young man.	Ran against post, and struck middle of abdomen.	Felt pain and became faint, then crawled 100 yards; collapse; vomiting; tumour in groin.	......	Tumour in groin easily returned, but soon came down again.	Death in two days; an irregular aperture in ileum, admitting finger; blood in sac and in abdomen.	Ditto.
4. Man, with inguinal hernia.	Kicked by wife on hernia.	......	Mortification.	......	Death.	Paris and Fonblanque, Med. Juris.
5. J. L—, æt. 29, congenital hernia.	Ran against post, injuring scrotum.	Vomiting.	Peritonitis.	Hernia reduced, and he walked into another ward.	Death in twelve hours; two small rosebud-looking wounds in lower part of ileum; plastic effusion and partial adhesion to surrounding parts; peritonitis extensive; gas and serous fluid escaped on opening abdomen; body warm.	Guy's Hospital.

6. T. Jones, æt. 49, sailor, small bubonocele on right, size of pigeon's egg; reducible scrotal on left, apparently omental, and existing for years.	Fell on right groin against a piece of wood.	Great collapse and pain; worked for half an hour after injury, carrying several sacks of flour, and then became faint.	Inflammatory symptoms; vomiting; fæces thro' wound on fourth day; gradual subsidence of symptoms; granulation of wound.	Local depletion; calomel and opium; R. hernial sac laid open on the second day, contents serum; no blood; no fæces; no odour; intestine at mouth of sac, left alone.	Recovery in ten weeks.	Guy's Hospital Reports, Apr., 1842, p. 267.
7. M. Hayes, æt. 40, scrotal hernia; denied previous existence of hernia.	Kicked by man on hernia, over scrotum.	Collapse for five hours previous to admission, and then not rallied; pain along cord, and hernia in scrotum.	Peritonitis.	Hernia reduced with facility; leeches; calomel and cathartic extract; hernia again descended; V.S.; blister to abdomen.	Death in thirty-six hours; ruptured jejunum one and a half inches above internal ring; fecal effusion in abdomen, and peritonitis; hernial sac contained some intestine, was large and of long standing.	B. B. Cooper, Surg. Essay, p. 275 (Guy's Hospital Reports, April, 1842, p. 272.)
8. John Cox, æt. 40, reducible scrotal hernia, wore no truss.	Kick from colt on hernia.	Walked to hospital with difficulty; then collapse; pain in sac.	Rapid peritonitis; extreme prostration.	Hernia returned to mouth of sac; leeches; castor oil; calomel and opium.	Death in thirty-four hours; rupture capable of admitting quill in ileum, seven inches from termination, lying near sac; fecal effusion and peritonitis; gas escaped on opening abdomen.	Guy's Hospital Reports, Apr., 1842, p. 274, Prep. 1851[88].
9. Stout, middle-aged man; reducible right scrotal hernia; wore truss.	Received blow on pad of truss, knocking it aside, and hernia immediately descended.	Pain and faint; sick; hernia partly returned, and sent to hospital on third day.	Vomiting; constipation; peritonitis; subsidence on third day of admission and sixth of accident; copious discharge of fæces through wound; continued four days; then passed naturally, and continued.	Hernial sac laid open on third day; no intestine is visible, but serum foretold a disturbance of sac; no fungoids.	Recovery at end of four weeks, and able to wear truss.	Ditto, p. 264.

	Cause.	Primary effects.	Secondary effects.	Treatment.	Post-mortem appearances.	Reference.
10. Cabinet maker, æt. 40; right inguinal hernia two years, wore truss, no descent for four months.	Pushing heavy table, slipped; truss struck edge of table.	Great pain; fainted; walked home in two hours; brought to hospital; sac empty; collapse; pain and nausea.	Acute peritonitis and incessant vomiting.	......	Death on fourth day; ruptured ileum, one and a half feet from cæcum, size of goose-quill; fecal effusion; peritonitis.	Path. Trans., vol. v, p. 170 (Mr. Shaw).
11. Congenital hernia, bowel and omentum adherent.	Struck groin against post.	Fainted.	Peritonitis.	......	Death on third day.	Sir C. Bell, quoted by Shaw, ditto.
12. Irreducible scrotal hernia.	Blow on hernia.	......	......	Sac laid open; bowel found ruptured; Lembert's suture.	Death within twenty-four hours after operation.	Jobert.
13. Carriage-driver, æt. 60, old hernia in left groin.	Kick by horse.	Collapse; great pain and tympanitis.	Peritonitis.	Reduction attempted; leeches	Death on second day; small bowel completely torn across and floating in abdomen; effusion of black matter; intense peritonitis.	Ditto.
14. Man, bubonocele, wore truss.	Blow on pad of truss from shaft of long hammer.	Restlessness, excruciating pain, and clammy sweats.	Next day great anxiety; pulse frequent, small; peritonitis.	Clyster returned, mixed with blood; castor oil; freely bled.	Death in forty-eight hours; circular aperture in ileum, size to admit goose-quill; castor oil floating about abdomen; peritonitis.	Travers, p. 36.
15. Man, hernia; no truss.	Pushed violently against wall by horse.	Cheerful; no collapse; violent pain in sac; no bowel in hernial sac.	Had no bad symptoms for forty hours; sudden prostration, and death in four hours.	......	Death in forty-four hours; ruptured bowel, one inch long.	Cæsar Hawkins (Lancet, 1839–40, p. 327).

Remarks.—The hernial protrusion in all the above cases was oblique inguinal, and occurred in males; in some the hernia was in the groin; in others the hernia was kept *in situ* by a truss; but, in the majority, the hernia was in the scrotum at the time of the accident. In thirteen cases the gut was ruptured by the injury, and all died; and in two only the bowel was bruised and sloughed, and recovery took place. These we shall first advert to, viz., Cases VI and IX; they are very much alike.

CASE VI.—Had a double hernia; a reducible scrotal on the left side, and a small inguinal on the right. He fell on a spar of wood on the right hernia; he worked for half an hour after, and then became collapsed; inflammatory symptoms and vomiting set in. The right hernial sac was laid open on the second day, but no blood, fæces, or peculiar odour observed; the intestine lay at the mouth of the sac, and was left alone. On the fourth day fæces passed through the wound, and an artificial anus resulted, which closed entirely in ten weeks.

CASE IX.—Received a blow on the pad of his truss, knocking it aside, and allowing his scrotal hernia to descend. This was partly returned, and he was sent to the hospital on the third day, suffering from peritonitis, pain, and vomiting; the sac was immediately laid open, and nothing found; mouth of sac not disturbed; and no purgatives allowed. Three days after the operation fæces escaped, and continued so for four days, when they ceased to do so, and recovery took place at the end of four weeks.

In both these cases, the aperture, if any, must have been exceedingly small; it is, however, more than probable that the bowel was bruised, and lost its vitality; the slough becoming fortunately detached at the neck of the sac; hence the successful issue. Again these cases are interesting, as showing the importance of laying open the sac, after blow thereon, whether there be intestine down or not, provided there be severe local or constitutional symptoms.

CASE XII.—Received a blow on an irreducible scrotal hernia. The sac was laid open, and the bowel found ruptured. The opening was closed by Lembert's suture. The patient, however, died in twenty-four hours after. This is the only other

case of the series, in which an operation was performed; here, however, the bowel was in the sac, and found ruptured. A question arises as to the propriety of employing the suture in such cases, and then returning the bowel into the abdomen; or whether it should be left alone in the sac.

In six cases the bowel was returned by taxis, notwithstanding there had been a blow thereon, and symptoms of severe mischief present. (Cases II, III, V, VII, VIII, and XIII.) Inevitable death resulted; their fate might have been otherwise, had the hernial sac been explored by incision.

CASE II.—Had a large scrotal hernia, and, although he was collapsed, and had vomiting, yet the hernia was reduced, and death occurred in five days. Ileum found ruptured to the extent of five inches, as also the mesentery; blood in sac, and three quarts of blood in the abdomen.

CASE III.—Does not appear to have had a hernia, but he was struck on the middle of the abdomen, which was followed by a tumour in the groin, and all the symptoms of a ruptured bowel. The tumour was reduced, but again appeared. Death followed in two days. A sac was found full of blood, as also a large quantity in the abdomen; there was an irregular aperture in the ileum.

CASE V.—Struck his congenital scrotal hernia against a post, and had vomiting. His hernia was reduced; he walked into another ward, and died in twelve hours. A very good lesson for us always to be on our guard when called to a person having struck his hernia.

CASE VIII.—Kick by colt on a scrotal hernia. Walked to the hospital with difficulty; had collapse, and pain in the sac. Hernia returned to the mouth of the sac, pure castor oil and calomel and opium administered. Death in thirty-four hours. Rupture of ileum near termination, and size of quill, lying near sac; fecal effusion.

CASE XIII.—Kick from a horse on an old inguinal hernia. Reduction attempted. Death in two days. Bowel completely torn across, and floating in abdomen.

Case vii is rather peculiar. He was kicked on his scrotal hernia by another man, and remained collapsed for five hours, and even then had not rallied; notwithstanding which the hernia was reduced, and calomel and cathartic extract administered. Peritonitis ensued. Blisters and venesection resorted to. Hernia again descended, and death in thirty-six hours. The sac was found to be large and of long standing, and contained healthy intestine. The jejunum was ruptured one and a half inch above the internal ring; there was fecal effusion. Was the jejunum in the sac in the first instance, and returned into the abdomen by the taxis, and afterwards sound intestine descended? We think not; intestines do not shift about so easily. It is more than probable that the blow was received above the internal ring, at the seat of rupture; but the man referred the sensation of having been injured on his hernia.

In three cases, although they were previously the subject of hernia, and had received a blow on the seat of the same, yet, after the injury, no intestine was in the sac, it being found empty. (Cases x, xiv, xv.) Still a surgeon would be perfectly justified in laying open the sac, with the hope and prospect of reaching the injured gut.

Case x.—While wearing his truss he struck it against the edge of a table, and then walked home; but in an hour or two was brought to the hospital in a state indicating severe internal injury. No hernia could be discovered, and the sac was empty. He lived four days; and after death a rupture of the ileum, one and a half foot from cæcum, was discovered, of the size of a goose-quill; there was fecal extravasation.

Case xiv.—Here also a similar accident occurred, viz., a blow on the pad of the truss. Symptoms of ruptured bowel supervened, but there was no hernia, or anything in the sac. Free bleedings were had recourse to, and the internal exhibition of castor oil. Death took place in forty-eight hours. There was an aperture in the ileum of size of goose-quill, and the castor oil found floating about the abdominal cavity.

Case xv.—Had a scrotal hernia and was pushed against a wall. Had at first violent pain in the sac, but there was nothing

therein. The man had no bad symptoms for forty hours, and was considered to be a case of but little moment, when sudden prostration came on, and death in four hours therefrom. There was found a rupture in the intestine about one inch long.

Three cases (I, IV, and XI) are but meagerly recorded.

Thus, Case I fell on his large scrotal hernia, and died in four hours. The ileum was found ruptured in the sac.

Case IV had a kick on an inguinal hernia, and died.

Case XI was the subject of irreducible congenital scrotal hernia, and received a blow thereon against a post, and died on third day.

In reviewing the whole of these fifteen cases, we may draw a few practical hints: viz., that in all cases where there has been a blow on a hernial sac, never to attempt reduction, and if the symptoms be urgent the surgeon should explore the sac at once, whether it is empty or not.

F. RUPTURE OF THE LARGE INTESTINES.

This portion of the alimentary canal seems to escape in a very marked degree, and may for most part be owing, first, to its position, skirting the circumference of the abdominal cavity; secondly, to its being strengthened by the longitudinal bands. We have but few cases adduced, although it is very probable that many more might have been found on due search and inquiry.

CASE I.—J. D—, a drayman. Crushed between two dray-wheels. Walked to the hospital on the morning of the accident, then went home to bed, and had no symptoms for some hours. In the evening had violent pain and vomiting. Peritonitis and collapse on the following day. Death in forty-two hours. Ruptured cæcum, allowing entrance of little finger. No extravasation or peritonitis. (Ellis, 'Lancet,' 1835, p. 18.)

CASE II.—Alex. M—, æt. 70. Fell from ladder some feet to the earth. Death soon after admission into the hospital. Cæcum distended, and its peritoneal surface softened, approaching gangrene and on point of giving way. Two of the longitudinal bands were ruptured. Eight upper ribs fractured,

but the pleura intact; also, fractured ileum. ('Guy's Hospital,' 1850.)

Case iii.—Man, æt. 46. Fell down while driving loaded coal-waggon; not known whether wheel passed over body. No external mark; no collapse; but pain in the lower part of the abdomen. He had also a compound dislocation of the toe, which was reduced. Three hours after, collapse, intense pain, and pulse imperceptible. Urine clear. Ordered morphia. Death in seven hours. Circular opening, size of sixpence, in lower part of sigmoid flexure; the mucous membrane protruded and everted; fecal extravasation. Ecchymosis and bruises of parietes; peritonitis. ('Path. Soc. Trans.,' vol. iii, p. 93.)

Case iv.—Passage of wheel over loins. Death. Rupture of junction of sigmoid flexure of colon with rectum. ('Bullet. de la Faculté de Méd. de Paris,' tom. i.)

Case v.—Man, kicked by a stallion colt in the hypogastrium. No external mark. Abdominal muscles tense and rigid; tenderness of the abdomen. Reaction; peritonitis on second day; tympanitis and vomiting. Urine scanty and required drawing off. Castor oil administered and an evacuation of the bowels previous to being seen by a surgeon. Leeches; hip-bath; enemata, followed by copious evacuation. Death in fifty hours. Lacerated descending colon, one and a half inch long, and just above the sigmoid flexure; fecal extravasation. Ruptured bladder at the posterior and inferior part. (Mr. Hole's case, 'Lancet,' 1851, vol. i, p. 381.)

We shall add little comment on the foregoing cases. The cases seem to be as fatal as those in the other part of the canal.

In order to give a general idea as to the duration of life in rupture of the several portions of the intestinal canal, we have drawn up the following table:

Duration of life.	Stomach.	Duodenum.	Jejunum.	Ileum.	Small intestine, not specified.	Ditto, complicated with hernia.	Blow on hernial sac.	Large intestine.
Few hours	...	...	2	1	...	...	...	1(?)
3 "	1	...	...	...	...	...	...	...
4 "	...	...	...	...	...	...	1	...
5 "	1	1	1	1	...	...	...	...
7 "	...	...	...	...	...	...	...	1
12 "	...	...	...	1	...	1	1	...
13 "	...	1	...	...	1	...	...	...
16 "	...	...	...	...	...	1	...	...
18 "	...	1	1	1	...	...	...	...
21 "	...	...	1	...	...	...	..	...
22½ "	...	...	1	...	...	...	...	...
24 "	...	...	...	4	...	...	1	...
28 "	...	...	1	...	...	...	...	...
30 "	...	...	1	2	...	...	...	...
31 "	...	...	1	...	...	...	...	...
34 "	...	...	...	...	...	...	1	...
36 "	...	...	1	1	...	...	1	...
42 "	...	...	1	...	...	...	...	1
48 "	...	...	2	2	...	...	4	1
3 days	...	1	...	...	...	...	2	...
4 "	...	...	...	...	...	...	1	...
5 "	1	...	...	...	1	...	...	...
6 "	...	...	1	...	...	...	...	...
8 "	...	...	...	1	...	...	...	...
16 "	...	...	...	1	...	...	...	...
2 months	...	...	...	...	1	...	...	...
Not stated	...	...	...	1	3	1	1	1
	3	4	14	16	6	3	13	5

Although we have here recorded sixty-four fatal cases of ruptured bowels—including two of probable recovery, had not pyæmia in the one instance, and hæmoptysis in the other, unfortunately set in,—against only two actual recoveries of questionable rupture; yet we cannot but feel convinced that some cases do and have recovered after rupture; and that many of the cases of injury to the abdomen followed by peritonitis and recorded as such, were truly those of ruptured bowel, of which no evidence could be satisfactorily offered.

Summary of the above Table of Duration of Life in ruptured Stomach and Bowels.

In drawing any conclusion from the above 64 cases, we must omit 7 cases, in which the time of death is not stated; and we must also exclude the case in which death did not take place until the second month, inasmuch as the case was one of recovery:—thus, then, we have 56 cases for comment: of these,

10 cases were fatal in the first five hours or stage of collapse, being 17·85 per cent.; of these 2 were of the stomach, 1 of the duodenum, 3 of the jejunum, 2 of the ileum, 1 of the bowel in a hernial sac, and 1 of the large intestine.

18 were fatal from five to twenty-four hours, during stages of primary and secondary effects, being 32·14 per cent.; of these 2 of the duodenum, 4 of the jejunum, 6 of the ileum, 1 of the small intestine (not specified), 2 of the intestine complicated with hernia, 2 of the bowel in hernial sac, and 1 of the large intestine.

Thus, within the first twenty-four hours, 28 cases, being 50 per cent., or half of the whole number, proved fatal in this period.

19 cases were fatal from twenty-four to forty-eight hours, during the acute and subsequent stages of peritonitis, being 33·92 per cent.; these include 6 of the jejunum, 5 of the ileum, 6 of the bowel in the hernial sac, and 2 of the large intestine.

9 fatal between the third day and the sixteenth day, during the reparative attempt, being 16·07 per cent.; of these 1 was of the stomach, 1 of the duodenum, 1 of the jejunum, 2 of the ileum, 1 of the small intestine (not specified), and 3 of the bowel in hernial sac.

In concluding this imperfect attempt at drawing the attention of the profession to this class of injuries, we have been mainly influenced by the fact that much injudicious and careless (we might almost say reckless) treatment has been resorted to. In the numerous instances here collected, we

have sad specimens of the action of purgatives in hurrying the unfortunate patient to a more speedy and inevitable death.

In more than one or two cases has the castor oil administered by the mouth, been found floating about in the peritoneal cavity.

Hence, then, how cautious should the surgeon be, when called to any case of injury to the abdomen, of however slight a nature it may be? The treatment in all such cases should be that which has been laid down in the early part of this communication, viz., perfect rest of body and perfect rest of bowels; no solid or fluid to pass into the stomach for at least forty-eight hours, and then only in small quantities, so as not to undo what slight reparative attempts have been made by nature: in some instances nature had almost completed her repair of the breach, when by injudicious treatment the temporary barrier has been forced asunder, and speedy death followed. And while again referring to this subject, we will conclude by adducing the following case:

Only a few weeks ago a boy was run over by the wheel of a carriage, and the mark of the track of the wheel was distinctly seen extending obliquely across the abdomen. The child was brought to Guy's in a collapsed state, became extremely restless and tossed himself about, evincing great pain and agony; he presented every symptom of ruptured bowel: he remained collapsed for several hours, and had nausea, &c. The boy was starved for forty-eight hours, and had opium in powder, and allowed to suck small quantities of ice at prolonged intervals. He recovered. The case, perhaps, was one only of shock without internal lesion; still it serves as a good typical case of not interfering in such injuries.

It was our intention to have associated with ruptured intestine *wounds of the intestines;* but we have already exceeded our allotted space: perhaps in another number we may give a collection of cases of wounds of the stomach, small and large intestines; wherein we shall find many interesting cases of recovery by judicious and careful treatment.

CASES

OF

PARAPLEGIA.

SECOND SERIES.

WILLIAM GULL, M.D.

The following cases of paraplegia, with those in the 'Reports' for 1856, though a miscellaneous contribution, may perhaps serve for reference in the absence of a more systematic treatise on the subject.

The labours of Lockhart Clarke, and Lenhossék on the minute structure of the nervous centres in health, cannot fail to give a new impulse to a more exact knowledge of the pathological changes to which they are subject. Something in this direction has been attempted. Those who are acquainted with the results of minute anatomy, as applied to the cord, will admit that we may now hope for an exhaustive morbid anatomy of it, exhaustive, at least, so far as to enable us to determine the state of the ultimate tissue.

Case XVII goes far to establish an important point in the pathology of paraplegia, namely, that the spinal centres may be paralysed without anatomical change of their structure. If this were certain it could not fail to give a new direction to our inquiries, and lead us with more earnestness to investigate the nervous substance by other means than the microscope. Dr. Sankey's observation on the variable specific gravity of the brain, lets in some light in this direction. It is from an increased knowledge of 'atomical,' as distinguished

from 'anatomical' conditions, that we may hope for future advances in nervous pathology.

Case XVIII presents a not uncommon history of chronic inflammatory degeneration of the columns of the cord almost latent up to a certain point, and then accompanied by a sudden aggravation of the symptoms. It may offer an occasion to remark that in diseases of the nerve-substance, acuteness of effects is no evidence of acuteness of the lesion producing them. In the brain this is notoriously true, for every one knows that a sudden hemiplegia may result from local changes of the slowest and most passive kind. The same occasionally occurs in the cord. The bearing of this on diagnosis and treatment is obvious.

Case XIX is a remarkable instance of the limitation of disease to the posterior columns. The lesion was of the same character as in the preceding case. The symptoms confirm the theory of Dr. Todd that the posterior columns are the channels through which the voluntary movements are coordinated. In this case there was not paralysis, but a want of controlling power. There was only a slight affection of sensation, proving also that the posterior columns are not mainly subservient to the sensory function.

Case XX presented at the bed-side a rare symptom in paraplegia, namely, paralysis of both seventh nerves. This prevented the pronunciation of the labial parts of speech, and led to a suspicion of brain-disease until the kind of defect was pointed out. This accident was explained by the condition of the medulla oblongata.

As it has been just remarked, on the one hand, that the character of a lesion of the nervous substance is not to be inferred from the acuteness of the symptoms in respect to their development in time, so it may be added, on the other, that the amount of the lesion is not necessarily in proportion of the gravity of the symptoms. A very small amount of anatomical disease, or, as we seem to have proved in Case XVII, not enough to be recognised, may produce fatal effects. The degree of positive lesion was appreciable in this case, but it was in amount trifling. It was its seat which gave it its importance. It is in the treatment that we need to bear these truths in mind, as no doubt there is a proneness in the mind, as before said, to

estimate the activity and violence of a disease by the rapid development and danger of the symptoms, and, consequently, to aggravate it by too heroical interference.

In Case XXI the limitation of the disease at its onset to the right side of the cord, and the suddenness of the early symptoms are the chief points of pathological interest.

The occurrence of erysipelatous inflammation from the incautious application of heat, is an accident to which paraplegic patients are notoriously exposed.

It does not seem unimportant to draw attention to the difference between capillaries mechanically incrusted with fat-globules as the result of disease of the tissue in which they lie, and that form of fatty degeneration which is precursory of atrophy.

Case XXII shows that the substance of the cord may be damaged by a violent exertion, without any affection of the bones, ligaments, or membranes of the spine. Whilst such injuries have an immediate interest to the surgeon, they have not less a deferred interest to the physician, who is often called upon to treat the subsequent effects. It is on this account that I have recorded this case and Cases XXIII and XXIV. In Case XXIII there was bruising and ecchymosis of the posterior columns and of the grey matter, followed by hyperæsthesia of the parts below. In Case XXIV there was, first paraplegia from concussion of the cord, recovery after a few hours; and subsequently, fatal paraplegia from extravasation of blood outside the theca-vertebralis along the spinal canal.

Cases XXV and XXVI are instances of progressive muscular atrophy from chronic disease of the cord. The early symptoms of such cases are like those which come on in lead-poisoning. The wrists drop and the hands become weak. It seems hardly necessary to assert that such symptoms are not pathognomonic of the presence of lead, as some have stated, for it must be obvious to any one who will consider the matter that in chronic affections of the cord in the cervical region the disease is not always so uniform in its seat and extension as to affect the muscles in the same order. In one case the arms may waste generally and equally throughout; in another, the scapular muscles and those of the shoulder may be first affected; and in a third, the interossei of the fingers,

the short muscles of the thumb, and the extensors of the wrists may first fail. The relation of the nerves of the brachial plexus to the cervical enlargement of the cord partly explains these differences, and what ramains obscure seems to require for its elucidation only a more accurate investigation of the distribution of the lesion through the cord in particular instances.

Case XXVII and XXVIII are recorded for the purpose of pointing out the occurrence of acute rheumatic symptoms after spinal lesions. Mere pain in the joints and limbs, generally, is not what is here meant. It is too common an error to account for obscure pains by calling them 'rheumatic,' to need any remark. The symptoms referred to are commonly regarded as pathognomonic of a rheumatic state, namely, swelling and redness of the joints; profuse acid sweats; high coloured, scanty urine, depositing urates; &c. Our ignorance of the essential nature of acute rheumatism, prevents our asserting or denying that it may have its origin in a disturbance of the nervous force, but certainly a condition apt to be confounded with it does so arise. In practice it cannot be an indifferent matter, whether according to popular pathology we set before us, as the object of our treatment, the elimination of a materies morbi, or a lesion of the nervous centres.

Case XXIX is remarkable for its clinical history, and the apparent contradictions which misled the diagnosis for the first two or three years. It was a case of chronic thickening of the spinal membranes implicating and destroying the posterior roots of the nerves of the brachial plexus. The disease was for some time so limited as to produce no other symptom than numbness of the left arm.

The test by galvanism, proposed by Duchenne, was entirely fallacious. This excellent author, in a *resumé* of his deductions on what he terms "faradisation," (electro-magnetism,) applied to pathology, gives the following conclusions in respect to hysteric paralysis:[1] 1. Electro-muscular-contractility is normal in hysterical paralysis. 2. Electro-muscular-sensibility is on the contrary generally diminished, or altogether absent.

[1] 'De l'Electrisation localisée,' p. 530.

3. Lastly, voluntary movements may be intact, notwithstanding the diminution or loss of the electro-muscular-sensibility.

All these conditions concurred in this case, and yet it was one of organic lesion of a serious kind.

The case affords a striking proof of the insidious origin and course of chronic spinal meningitis. The local action appears never to have been acute, and was unattended by those symptoms of irritation which are supposed to characterise inflammation of the membranes of the cord.

The changes in the cord were probably subsequent to those in the membranes and posterior roots of the nerves.

Cases XXX and XXXI are good examples of malignant disease about the spine affecting the cord. In one, the substance of the cord was sloughing; in the other, the proximity of the cancerous growth had induced only softening. In neither, was the nervous substance the seat of the new growth. At an early period, when there is nothing tangible, the symptoms in such cases are commonly referred to neuralgia; the word 'neuralgic,' for explaining symptoms, as the word 'idiopathic,' for explaining causes, being of so easy use that it invites careless investigation. But, for this, there are generally circumstances which would suffice for a sound diagnosis. The pain is more or less characteristic in its continuance and severity. Its seat about the spine is also a sufficient cause of suspicion, since this region is not commonly affected with pure neuralgia; added to which, collateral symptoms, if sought for, are often found to remove the difficulty. For instance, signs of pressure on the bronchi, where the dorsal region is the seat of the disease, or, as in Case XXX, the invasion of an adjacent organ by the malignant growth.

Case XXXII is one of strumous tubercle developed towards the centre of the cord. The chief value of the case lies in its history, for the patient being an infant, as the arms only were at first affected, the paralysis might not have been regarded as of serious importance. Young infants are occasionally the subjects of paralysis of one or both arms, from the carelessness of nurses in tying the dress so as to produce pressure on the axillary plexus. Not unfrequently also the paralysis of the period of dentition, the 'paralysie essentielle' of French authors, shows itself in one or both arms, whilst the legs

remain unaffected. In both these forms the onset of the paralysis is sudden, and by that alone they would be distinguishable from such a case as the above.

CASE XVII.—*Complete paraplegia without loss of sensation; onset of symptoms sudden; (acute tabes dorsalis.) Death after fourteen days from acute peritonitis set up by inflammation of the bladder; no discoverable change in the structure of the cord beyond slight softening of the texture; no exudation.*

(*Reported by* Mr. DURHAM.)

Henry P—, æt. 32, clerk to a solicitor in the city, was admitted under my care into Guy's Hospital, 23d December, 1857. A tall, well-made, rather pallid, but otherwise healthy-looking man, suffering from entire paraplegia of the lower extremities and sphincters, but without affection of sensation. He stated that he had never previously had any serious illness, but that two years ago he fell whilst attempting to jump over some chairs. After a few days, all apparent effects of this accident passed away, and he considered himself in unimpaired health. In the summer of 1857, he married, and gave himself to excessive indulgence in sexual intercourse. He was otherwise temperate. For two or three months preceding the sudden development of the paraplegia, he experienced at times some difficulty in micturition. The urethra was healthy. On the 9th of December there was numbness of the lower extremities extending as high as the knees, but this was so slight as not to attract any attention at the time. On Monday the 14th, he walked as usual from the suburbs to his business in the city. About the middle of the day, as he was crossing his room, his legs suddenly became weak, and he would have fallen had he not been supported. After a short time, he recovered sufficiently to walk with some difficulty to the omnibus, and afterwards from the omnibus to his home. In the course of the afternoon he became entirely paraplegic, the urine and fæces passing involuntarily from him. There was no affection of the upper extremities except slight and transient formication in the hands.

On admission, on the 23d, there was only a trace of excito-motor activity in the left leg, and none in the right. There was no appreciable diminution of sensation. Movements in the chest normal. Pulse 120, feeble. Pupils dilated. Surface of trunk and upper extremities warm and perspiring. Legs cold. A sense of tightness around the chest, about the attachment of the diaphragm. Bowels inactive. Urine drawn off by catheter, acid.

The day following his admission, there was noticed to be some œdema of the integuments in the lumbar region, especially on the right side. On the 26th, this had almost disappeared. The spine was normal. No change in the paralytic symptoms. Occasional slight involuntary twitchings of the legs. *Electro-contractility of the muscles good.* Only the slightest trace of excito-motor action and that limited to the left leg. The integuments over the sacrum reddened. Pulse 130. Skin hot and dry. Urine ammoniacal, and containing a large quantity of very offensive mucoid pus. The passage of the catheter was followed by much bleeding. During the night of the 28th nausea and vomiting came on, with great prostration. Respiration

thoracic. Death from exhaustion on the morning of the 30th, the case having been brought to a rapid termination by the supervention of acute peritonitis upon inflammation of the bladder. The upper extremities were unaffected throughout with the exception of the slight and transient formication noticed above.

Post-mortem examination.—Head not examined. About the base of both lungs, commencing acute lobular pneumonia. Lung-tissue otherwise healthy. Heart healthy. Intestines covered by recent inflammatory exudation. Mucous membrane of bladder sloughing. Its muscular coat, and the pelvic areolar tissue, infiltrated with fetid pus and urine. Two false passages, one passing through the prostate and thence into the bladder, and the other passing into the areolar tissue behind it. No stricture of the urethra. Texture of kidneys healthy. No trace of old or chronic disease could be discovered, either about the pelvis, in the pelvic viscera, or in the bodies of the vertebræ. The larger veins were opened, but afforded no evidence of phlebitis. Integuments over the sacrum beginning to slough, over the lumbar region they were œdematous. Membranes of the cord healthy. As the finger was passed lightly along the body of the cord it appeared to be somewhat softened at two points, in the middle, and at the lower part of the dorsal region; but on the most careful microscopical observation nothing abnormal was discovered in the texture either at these parts or in any other, though the cord was submitted to repeated and searching examination by the microscope. The epithelium lining the ventricle of the cord in the lower dorsal and lumbar regions was abundant, but normal. A few granules of brain-sand were found in the posterior columns, about the middle of the dorsal region. No traces of inflammatory exudation anywhere, either in the cord or in its membranes, nor any evidence of degeneration of the nerve-tubules.

Remarks.—When this patient came under care it was thought that the paraplegia was the result of ramollissement of the substance of the cord, which had (as not unusually happens) been more or less latent in its progress, the sudden paraplegia coming on when the conducting tubules have reached a point of degeneration which destroys their continuity. The examination of the cord did not confirm this diagnosis. In

the present state of nervous pathology, the case remains unexplained. It is confessedly difficult to establish a negative, but the difficulty was met with unusual care in this case. Hours were spent in the examination of the cord, but with no other result than to show that there was no appreciable lesion of it, besides a slight and doubtful softness of the tissue at two points. We may, therefore, certainly conclude that the spinal cord may have its functions impaired and even lost, and that suddenly, as far as the power of motion is concerned, without any distinct amount of anatomical lesion. Some writers have thought that the cord might be paralysed by a morbid impression made upon it, through incident nerves, and independently of any lesion of structure. Mr. Stanley sought to establish this in reference to disease of the kidneys, believing that these organs when congested, might, through their nervous connections, set up paraplegia. I have shown in another place ('Med.-Chir. Trans.,' 1854), that the cases recorded by that author do not support his theory. In the instance before us, there was no lesion of the kidneys or of the pelvic viscera, preceding the paraplegia; nor does there in the history of the case appear to be any sufficient cause for the paralysis, unless we accept it as one of acute tabes dorsalis, resulting from over sexual indulgence. Had the case not been rapidly terminated by cystitis and acute peritonitis, the cord, examined at a more advanced period, would, in all probability, have presented definite degenerative changes; or, perhaps, it might have recovered itself by the slow processes of nutrition. It is worthy of notice, that sensation was not affected. In the treatment, cupping, blisters, and mercury, would have been obviously inappropriate. Wine and opium moderately in the beginning; and at a later stage the mineral tonics, were the means indicated; but, unfortunately, as too often happens, the accidents of the paraplegia, the pelvic complications, gave no opportunity for the successful issue of the case. In this respect, women have the advantage over men, catheterism being less needed, or when required, less liable to produce injury in them than in the male sex.

CASE XVIII (Plates I, II).—*Numbness and weakness of legs for several months; sudden onset of pain and increased debility; no impairment of sensation; temporary increase of voluntary power under the use of strychnia, soon followed by complete paraplegia; retro-peritoneal abscess between bladder and uterus. Death from peritonitis: remarkable atrophy of the gray substance of the cord; chronic inflammatory degeneration of the posterior columns.*

(*Reported by* Mr. DURHAM.)

Harriet B—, æt. 50, (?) but looking much older. A widow employed as a nurse. Admitted into the hospital 10th December, 1857. Seven weeks before this, she was suddenly seized with acute pain in the right foot, so severe that she could not move the leg. In a few days the left foot was similarly affected. The pain gradually subsided, but only to return at intervals as severely as ever. The muscular power became at the same time impaired. She could move the limbs when lying down, but not leave her bed. On questioning her, it appeared she had for some time felt uncomfortable sensations in the legs, with slight numbness, and a feeling of debility, but was able to perform her duties until the time of the sudden seizure of pain. When she came into the hospital, there was only just sufficient voluntary power over the legs to flex them slightly, the left rather the most. Occasional feeble involuntary jactitations, and distinct but not very marked excito-motor movements. Sensation not impaired. Urine drawn off by catheter, ammoniacal and containing mucus. Pain over the abdomen; occasional vomiting. Strychnia was given in doses of 1-16 grain. Under its use the voluntary power was for a few days rapidly increased, but at the end of a week the spasms of the legs were so violent the medicine could not be continued. The cord wasl eft exhausted, and, at the end of five weeks after her admission, the legs were completely paralysed, and no excito-motor movements could be produced. Sensation now seemed to be impaired, but the patient at this period of her illness lay for the most part in such a dull and stupid state, that it was difficult to form a satisfactory opinion on certain points. The skin was abraded over the sacrum and trochanters. Highly offensive urine dribbled from the bladder. She would not submit to have anything done with the catheter, on account of the pain it caused her. She lay in a state of semi-coma, and died exhausted, February 5th, 1858.

Post-mortem examination.—Body wasted. Head not examined. Spinal bones, ligaments, and theca-vertebralis, healthy. Arachnoid normal, with one or two fibroid plates on the visceral layer. Spinal cord in the lower dorsal region small, and soft to the touch; the anterior fissure gaped open. Examined in the fresh state, abundant granule-masses (exudation-cells, &c.), having the usual appearance, were found in the columns. On section, the centre of the cord formed an

irregular depression from atrophy of the gray substance. These changes were, however, more definite after the cord was hardened by immersion in spirit and thin sections made of it. The atrophy affected the fibrous portion of the gray substance. The caudate vesicles had their normal position and structure. There was no exudation amongst the gray substance. The symmetry of the changes in the columns, and the mode of extension of chronic disease in them, are well shown in Plates I and II. The lesion was due to chronic inflammation and concomitant atrophy of the tissue, with subsequent fatty degeneration of the newly effused matter. The fatty incrustation of the capillaries was a mechanical result, as shown in Case XXI. Cortical portions of both kidneys full of points of suppuration. Pelves, ureters, and bladder acutely inflamed. A large retro-peritoneal abscess between the bladder and uterus, but not communicating with the bladder. Recent inflammatory effusion over several coils of intestines in the pelvis. Viscera of chest healthy.

Remarks.—An inspection of the sections given in Plates I and II will show how much could be expected from treatment. It cannot be objected that the lesion there depicted does not convey a true impression of what existed during life, since there is no evidence of recent changes. It is an important consideration in the treatment of diseases of the nervous centres, how far the symptoms are due to irremediable changes or not. A lesion of the nervous tissue may be cured—or, at least, be in a state which, if it were in the skin, or muscle, or gland, would be called cured—and yet, according to the patient's estimation, the disease may remain. We too often think of symptoms as substantially the disease; and if this false view guides our treatment we cannot fail of doing harm. We waste the feeble powers of an already partially dilapidated system, instead of recognising the dilapidation as an essential and permanent condition of the body we have to treat.

The therapeutical agency of strychnia in organic lesions of the cord has yet to be proved. Judging from its effects, we should say its direct operation on the tissue was the very reverse of nutritive or reparative. If function is, as there can be no doubt, the effect of a mode of disintegration, agents

which directly increase function must produce a disintegrating action. If this be a sound inference—and experience leads to the same conclusion—strychnia has but a limited therapeutic application in paraplegic affections. It is well known that immediate and striking effects can be produced by this drug, but these are often followed by hopeless bankruptcy of the spinal power. In giving strychnia, our object should be to produce no greater change of the tissue than shall, by the stimulus of waste, increase the power of nutrition, as we exercise an organ to favour its healthier growth. This requires not only a diagnosis of the conditions producing the paraplegia, but a careful adaptation of the dose of the medicine, which is often a difficult point. I have seen one twenty-fourth of a grain given twice a day for only two or three days, in a case of chronic paraplegia, apparently depending upon softening of the cord, set up very decided irritation. So unstable is the structure of the nervous tissue in some of these cases, and so delicate, in proportion, must be our interference by remedial agents.

CASE XIX (Plate III, A, B).—*Chronic inflammatory degeneration of the posterior columns of the cord throughout their whole length. The disease strictly limited to the posterior columns. Frequent vomiting. Emaciation of the voluntary muscles generally. Paraplegic weakness of lower extremities, characterised by a want of control over the contraction of the muscles. Congenital misplacement of the ascending colon, which became twisted on itself. Cæcum sloughing.*

William J—, æt. 28, of the middle stature; fair hair; emaciated; anxious expression; large head; broad and prominent forehead. Though he had never been robust, he had good health until the beginning of the year 1857. He was first seized with vomiting, which came on without any discoverable cause, and lasted for several days. As he recovered from the attack the legs became weak. After three months he had a second attack of vomiting, followed by an increase of weakness in the legs. He was admitted into Guy's Hospital under my care, November 11th, 1857. He was then unable to stand without support. In a recumbent position he could flex and extend the legs with some freedom, but the movements were sudden and vague, from want of control over the action of the muscles; the spinal centres, when stimulated by the will, seeming to shoot off their influence at once, making the feeble muscles contract to their full extent with a jerk. In other words, there was no power to regulate the muscular contraction. The movements of the fingers

were also wanting in precision. He was awkward in handling small objects, or in applying the hand to grasp larger ones. The muscles were thin and flaccid, corresponding to the general emaciation of the body. The muscular irritability was excessive. Weak currents of electricity, not sufficient to affect healthy muscles, excited well-marked contraction; whilst a little stronger, but yet very moderate dose of electro-magnetism, produced cramps lasting for several seconds after the stimulus was discontinued. The arms were weak, with an obvious want of control over the voluntary movements. There was numbness of the feet and hands, and a burning formication in the fingers and toes. The sensation of the other parts of the body was normal. No involuntary contraction of the legs. Sphincters good. Urine acid. The lower ribs depressed, and but little moved in inspiration. Headache; vertigo; cerebral confusion; tinnitus. Pupils largely dilated, the left the most so; sight dim; occasionally transient amaurosis. Sleep disturbed by dreams. Frequent nausea and vomiting, with pain from the epigastrium to the spine. Abdomen not distended; soft. Skin hot and perspiring. Pulse permanently quick, 126, small, and feeble. Respiration 32. Spine straight. No tenderness on pressure or percussion. He could give no account of any accident or injury to the spine, except such as might have resulted from a fall, flat on the back, from the height of a few feet, eight years before his symptoms began. His habits had been temperate. No syphilitic taint.

After admission into the hospital he continued to have repeated attacks of vomiting, lasting for many days, uninfluenced by any remedies. The vomited matters were copious, greenish, and mucous. The bowels continued to act freely, but without relief to the sickness. The irritability of the stomach was attributed to the state of the cord. The attacks of vomiting increased his anxious aspect. The paraplegic symptoms continued unchanged. There was, as before noted, headache and vertigo, and sometimes transient amaurosis. The pupils remained permanently dilated, and with the same inequality. The pulse quick (120 to 130), and feeble. On only one occasion was the urine noticed to be alkaline, when first passed. It never contained mucus. There was no band-like sensation around the abdomen. He often complained of pain from the epigastrium through to the spine. About the middle of February, 1858, he first had a sense of bearing down about the rectum, and complained of great distress after an action of the bowels, and of startings in the legs. March 8th he had an attack of vomiting, apparently such as had often occurred before. This continued on the 9th. On the 10th he was collapsed and pulseless, with cold sweats, and other symptoms of ruptured intestine. There was no cerebral oppression. He died on the 11th.

Post-mortem examination.—Body emaciated. Brain healthy. Thoracic viscera healthy. Fecal extravasation into peritoneal cavity. Intestines adherent by recent lymph. Omentum contracted into a cord-like mass, and firmly adherent to the left side over the pubis. Cæcum fallen into the cavity of the pelvis. From it the ascending colon passed directly to the left side towards the spleen, and then curved down again before becoming continuous with the descending colon. This displacement of the cæcum and ascending colon arose from a

congenital (?) absence of the meso-colon on the right side. The ascending colon, at its commencement, was partially twisted upon itself. Both it and the cæcum were dark coloured, and sloughing to a large extent, from mechanical obstruction. The spinal cord had its normal appearance and consistence, except, perhaps, a small portion in the dorsal region, which seemed rather softened; but this was doubtful, and was only such as an accidental tension in moving it from the canal might have produced. Sections of the cord made at the time gave no further evidence of disease. The membranes were healthy. After hardening the cord, and making fine sections, it was seen that the posterior columns were atrophied throughout their whole length, and amongst the tissue were numerous exudation-cells in a state of fatty degeneration (granule-cells). The posterior roots and the lateral columns were normal (Plate III). The disease was limited above by the commencement of the medulla oblongata. No degeneration of structure had occurred in this part.

Remarks.—The relation of morbid conditions to each other is often difficult to determine. It was so in this case. The oldest disease was no doubt that discovered in the abdomen; the absence of the meso-colon on the right side was evidently congenital, and probably the adhesion of the great omentum dated also from an early period. It was these lesions which brought about the fatal result. The steps of the process may be looked at in two ways. It may be admitted that a cæcum and colon left to float free were in danger of getting into positions unfavorable to the propulsion of their contents, and thus of occasioning attacks of vomiting, such as ushered in the other symptoms in this case, and continued to harass and distress the patient throughout his illness. It may also be thought probable that attacks of abdominal disturbance might, through incident nerves, set up a secondary lesion in the cord. This, however, is doubtful, and it is more in accordance with our pathological views to refer the early attacks of vomiting to the lesion of the cord itself, as the primary disturbance, especially since the degeneration of the columns extended up to the neighbourhood of the medulla oblongata. With this view, it is not difficult to understand

how the congenital defect in the colon should be brought into fatal operation by irregular peristaltic action so induced.

The limitation of the disease to the posterior columns was remarkable (Plate III, A, B). Though they were degenerated throughout their whole length from the lumbar portion to the medulla oblongata, neither the posterior roots of the nerves, nor the adjacent parts of the lateral columns, were in any way involved in the degeneration. We might, from this strict limitation of the lesion, hope to gain some unequivocal evidence as to the physiology of these structures.

The affection of sensation was limited to numbness, and formication of the hands and feet. Dr. Brown-Séquard has shown, by transverse section of the posterior columns in animals, and by instances of disease in the human subject, that where the posterior columns are destroyed for a limited extent, as by pressure of a tumour, hyperæsthesia is produced in the parts below the injury; in both extremities if the lesion affects both columns, but only on the side of the lesion if one column is affected. When, however, the posterior columns are destroyed throughout their whole length, instead of hyperæsthesia, there is loss of sensibility to some degree. Not that the posterior columns convey, according to this observer, sensitive impressions to the brain, but, because, being in part channels through which the fibres of the posterior roots reach the gray matter, if they are destroyed or degenerated throughout, a certain number of sensitive fibres must be destroyed also. So far theory coincides with the facts noticed in this case.

The same physiologist believes that the special function of the posterior columns is for the reflex movements. These functions ought, therefore, to have been destroyed, or at least greatly diminished. Nothing in favour of such a theory was, however, noticed, except the general muscular emaciation.

The sphincters of the rectum and bladder continued to perform their office. The muscles remained in a state of hyper-excitability to the galvanic stimulus. I do not know how far the state of the colon might be referrible to a loss of the reflex power.

Neither were the phenomena more in favour of the value of the test proposed by Dr. Marshall Hall, for the diagnosis

of cerebral paralysis from spinal paralysis, since according to that, the irritability of the muscles should have been much diminished, the disease being in the cord; but, on the contrary, it was remarkably increased.

This brings us to the theory of the posterior columns proposed by Dr. Todd, that they "propagate the influence of that part of the encephalon which combines with the nerves of volition to regulate the locomotive powers, and serve as commissures in harmonising the actions of the several segments of the cord." The want of power in this case to regulate the action of the muscles was very characteristic. The legs, when drawn up, as they could be freely, were drawn up with a sudden jerk, and extended in the same manner. The voluntary movements of the hands were also fumbling and vague.

The limitation of the disease to the posterior columns, coincides with what is generally found. There is evidently a tendency in lesions to spread longitudinally in the cord rather than transversely through it. Probably from homogeneity of structure or from the arrangement of the blood-vessels.

Such complete and symmetrical isolation of a structure is very suggestive of an independent function.

It is unnecessary to refer particularly to the character of the morbid changes in this case. They were evidently of that kind which we denominate by the term "chronic inflammation." Atrophy of the proper tissue, with exudation, which corpusculates and then becomes fatty. This change was probably induced by the fall on the back eight years previously.

In the ordinary mode of examination the disease of the cord in this case must have been overlooked, and it would probably have been regarded as one due to cerebral disease, though certainly there was no evidence of it post mortem. Clinically, there was more to support such a view, namely, headache, vertigo, cerebral confusion, tinnitus, dilated pupils (one larger than the other), dim vision, occasionally transient amaurosis, sleep disturbed by dreams, &c. These symptoms—together with power to move the limbs when in a recumbent posture, but inability to stand without support, and apparently a great increase of all the symptoms when the patient is in a

vertical position—led Dr. Baillie to assume that the seat of the disease in these cases is in the encephalon. In the year 1848 I proposed a classification of paraplegia which should recognise the existence of such cases; but a better method of investigating the morbid changes in the cord daily lessens the number of instances referrible to such a division, and makes it doubtful whether paraplegia properly so called is ever due to lesions which are strictly cerebral in their seat.

CASE XX.—*Paralysis of both seventh nerves; nearly complete paraplegia of lower extremities; weakness of upper extremities; onset of symptoms acute. Death on the ninth day. For some months preceding the invasion of the paraplegic symptoms pains in the left arm and slight wasting of the muscles, supposed to be rheumatic; wasting of the gray commissure on the left side of the cord in the cervical region; recent inflammatory exudation into the tissue of the medulla oblongata and into the gray commissure of the cord.*

Mr. E—, æt. 59, began to suffer from pain in the left arm, from the shoulder to the elbow, at the end of the year 1856. The pain continued some months, and left the arm weak and slightly wasted. This was regarded as a rheumatic affection. There was no anæsthesia; Mr. E— was in other respects in good health until Christmas, 1858. He could give no more precise description of the beginning of his indisposition than that he was languid. He spoke also of an occasional feeling of coldness between the shoulders and down the spine, attended with distressing rigors in the spinal muscles. At the beginning of March, 1858, he had bilious vomiting, with pain in the right hypochondrium. He was able to continue the active duties of his profession as a medical practitioner, and gave a public lecture on the evening of the 29th of March, but said that he felt more weak and tremulous on that day than usual. He visited his patients on the 30th, and appeared in his ordinary health, but in the evening complained of constricting pains in both arms, from the shoulders to the insertion of the deltoid muscles. On rising from bed on the morning of the 31st he found his legs too weak to support him, and from that time his paraplegic symptoms rapidly increased. I visited him on the 4th of April. There was then entire inability to move the muscles of expression on either side of the face. The involuntary action of the orbiculares palpebrarum continued, but the eyes could be only partially closed by volition. The features hung motionless. He first noticed the paralysis of the face the day previous, when attempting to put up his lips to kiss his wife. The motor and sensitive divisions of the fifth nerves were unaffected, except slight anæsthesia of the first division on the left side. Motions of the eyes, vision, hearing, taste, and deglutition normal. Respiration chiefly abdominal, the movements of the lower ribs being defective. Numbness of the fingers

of both hands. Movements of upper extremities free. He lay supine with the legs extended and powerless. Muscles flaccid. No excito-motor movements on irritatating the soles of the feet; sensation impaired, and a feeling as of a board pressed against them. The sphincters retained their power. Urine pale straw-colour, acid. Intellect perfectly clear. Tongue protruded straight. Articulation perfect for all words not requiring the use of the lips. Labials could not be pronounced. Pulse 72. Respiration tranquil. On closer inquiry as to any premonitory symptoms it was elicited that, in the summer of 1857, on one occasion, in sleep, an evacuation had passed from him involuntarily. This was the only evidence of spinal disorder, except that given above. On the 6th there was a slight return of power over the muscles of expression. The paraplegic symptoms, however, were unchanged. On the 8th the respiration was more feeble, and chiefly abdominal. Tongue dry and brown. Dribbling of urine. When roused he was quite collected, but left to himself there was wandering delirium. Movements of arms very feeble; slight subsultus. He died in the evening very tranquilly, the breathing ceasing so gradually that the last respiration could not be told.

Post-mortem examination.—Rigor mortis well marked, both in upper and lower extremities. Large amount of subcutaneous fat over chest and abdomen. Muscles of lower extremities well developed. Left arm slightly less muscular than right. Large deposit of fat about the base of the heart and over the right ventricle; valves healthy; aorta extensively atheromatous. Lungs healthy. Universal, old, tough adhesions between the diaphragm and upper surface of liver. No corresponding adhesion of the pleura above. Kidneys large, tunics easily stripped off; surface smooth. Bladder healthy. The convolutions of the hemispheres of the brain separated by clear sub-arachnoid effusion. No other abnormal change. Corpora striata, thalami optici, cerebellum, and pons varolii healthy. The basilar and vertebral arteries opaque and rigid. The trunks of all the cerebral nerves healthy. Bones, ligaments, and membranes of the spine healthy. In the cervical and dorsal regions the substance of the cord was to the touch somewhat softer than natural, but no other unequivocal change was discoverable by the unassisted eye or by the aid of a common lens. On hardening the pons varolii, medulla oblongata, and cord, and preparing sections after a modification of Lockhardt Clarke's method, it was seen that in the anterior part of the commissure, throughout the length of the cord, but principally in the lumbar and superior cervical regions, and throughout the structure of the medulla oblongata, but chiefly at its superior part, there were exu-

dation-cells scattered interstitially amongst the tissue; they were also seen, but more sparingly, in the lines of areolar tissue which radiate through the white substance and amongst the deeper part of that which dips into the anterior commissure. There was no want of continuity nor any destruction of the nervous tissue. The cells were recent. They had not undergone fatty degeneration. The amount of the exudation was so small and its distribution such that no lesion was visible, except under the higher powers of the microscope. It was then very distinct, and remains so in the sections preserved in Canada balsam. In the cervical region on the left side there was wasting of the gray commissure and a development of fibrous tissue in its place.

Remarks.—The supposed rheumatic affection of the left arm was referrible to the changes in the gray commissure in the cervical region. This change was very limited in extent, but still very definite when transparent sections of the cord were examined. The experiments of Brown-Séquard—which go to prove that injury to the gray matter of the cord on one side alters the sensibility on the opposite side of the body—seem opposed to the facts in this case. It is probable, however, that the painful affection of the left arm was due to a lesion of the motor nerves—the chronic changes in the muscles subjecting the textures to unnatural tension.

The paralysis of both seventh nerves was a striking incident in the case. It was referrible to the central changes which extended through the tissue of the medulla oblongata. The nerve-trunks and surrounding parts were healthy. The exudation estimated in mass was very trifling, not sufficient indeed to give unequivocal evidence of its presence but for our improved methods of research. It is not, however, to be forgotten that its seat was in the most important part of the nervous centres, where nature has afforded no surplusage.

The defective speech led those about the patient to suppose the symptoms were due to disease of the brain. It, however, needed but little investigation to show that this defect was entirely due to paralysis of the lips, and was limited to the pronunciation of labials, other parts of speech being pronounced distinctly.

The intellect was undisturbed. The patient gave a very clear

account of himself. The tongue was moved freely. Digestion unimpaired, and the breathing natural.

The diagnosis was of softening of the cord, but strictly speaking this was not the lesion. It was an inflammatory exudation into the more vascular parts of the cord and medulla oblongata. To what condition of the circulating fluids or of the blood-vessels this was attributable is conjectural. The patient was a beer- and porter-drinker, his subcutaneous tissues were loaded with fat, his age 59:—conditions which are associated with and favour a gouty state, no doubt much oftener than the occurrence of distinct gout would seem to indicate, for a patient may be gouty who has never had gout, as one may be poisoned by marsh miasm who has never had ague. There was no history of injury or of exposure to cold. The effusion under the cerebral arachnoid was probably the result of that capillary paralysis (congestion) which comes on in death from disease of the nervous centres.

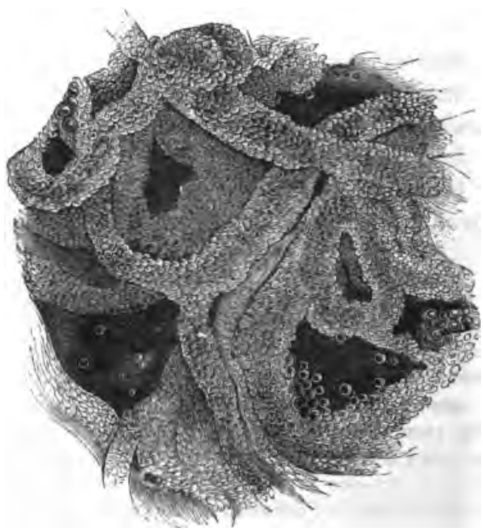
Case xxi.—*Sudden paralysis of right leg; partial recovery, after five months, acute paraplegia; erysipelas and consecutive pneumonia from the application of heat to the legs. Irritative fever, and death in two weeks. Recent softening of the cord in the dorsal region; old degeneration of the right lateral column, with fatty incrustation of the capillaries.*

Ed. M—, æt. 34, a man of dissolute habits, but originally of a strong and well-developed constitution. At the end of November, 1853, on rising from his bed felt himself suddenly powerless in the right leg. He had at the same time pain in the lumbar region, extending to the hypochondria. There was no anæsthesia. He asserted that he had felt nothing wrong with himself previously; and, so far as he knew, there had been no premonitory symptoms of the paralysis. For more than a month the leg remained completely paralysed, "there was not the slightest power of motion in it." Pain in the course of the sciatic nerve. Urine drawn off by the catheter; ammoniacal. Frequent priapism with spermatic discharges (as proved by microscopic examination), but he was not himself aware of any excitement of the genital organs when questioned about it. He was treated by Mr. William Hills with laxatives, the preparations of iron and strychnia, and by galvanism. Slowly the pain left him, and he recovered some power over the leg so as to be able to stand upon it, and to walk with the aid of a stick, but he could not flex the muscles of the hip-joint. With this improvement, he relapsed into his former habits, and after a week rather suddenly became paraplegic. He was admitted into the hospital April 29th, 1854. The right leg was then wasted and completely para-

lysed. Slight power remained in the left leg, and there was frequent involuntary jactitation of it. It was swollen from erysipelatous inflammation which had extended from a bulla caused by the application of a hot bottle. Irritative fever followed, and death at the end of a fortnight from the time of the relapse.

Post-mortem examination.—On the left leg superficial excoriations and the remains of blebs. Subcutaneous cellular tissue containing collections of pus. Saphena vein not implicated. Bones, ligaments, and membranes of spinal cord healthy. Large quantity of transparent cerebro-spinal fluid. In the upper dorsal region the substance of the cord was softened to the extent of an inch; exudation-cells scattered through the tissue. In the right lateral column, near the same part, the tissue was atrophied and the capillaries incrusted with oil-globules (fig. 1).

Fig. 1.[1]



The fatty matter could be removed by ether, leaving the walls of the vessels apparently normal. This change was strictly limited to the right side of the cord. Recent lymph on lower lobe of right lung. Pneumonic consolidation of the bases

[1] Sketch of capillaries incrusted with oil-globules, case xxi.

and posterior parts of both lungs. Liver pale, weight four pounds three ounces. Kidneys congested, weight 12 ounces. Mucous membrane of bladder thickened, congested, and greenish.

Remarks.—The chief pathological interest of this case lies in the suddenness of the paralysis in the first instance, and its limitation to the right leg. The cause of this was plainly made out on examination of the cord. The incrustation of the capillaries with oil-globules appeared to be nothing more than a mechanical result, and not due to a degeneration of the coats of the vessels. In pathological changes of the nervous substance we may distinguish these two conditions. In the one, the changes in the capillaries are probably antecedent to the lesion of the textures, and in the other consecutive to it.

It is a matter of speculation what set up the softening. Dissolute habits induce many conditions predisposing to such a change; and amongst them, perhaps, none more efficient than the contamination of the syphilitic virus. In softening of the brain there can be no doubt of this connexion, and that, too, apart from any noticeable cachexia.

The seat of the softening corresponded with that so frequently found in other cases. The dorsal region, from its position and organization, is exposed to lesion, and the cord has, perhaps, at this part, less resisting power than at other parts which are more highly organized.

Case xxii.—*Paraplegia supervening two days after a violent exertion in lifting a heavy weight; softening of the cord opposite the fifth and sixth dorsal vertebræ; no injury of the membranes, ligaments, or bones of the spine. Death after six weeks.*

Richard A—, æt. 25, of a rather delicate constitution, was at his usual occupation as a labourer in the Commercial Docks, on Saturday, November 22d, 1856, when, after lifting some deals, he felt a sudden pain in the back. He walked to his home, the distance of a mile and a half, and the following day was apparently quite well. The next morning (Monday), on waking, the legs were paralysed. When admitted into the hospital, November 26th, there was complete paraplegia, a bed-sore had already begun to form over the sacrum, and ammoniacal urine dribbled from the bladder. He died exhausted, January 2d, 1857.

Post-mortem examination.—Body emaciated; large bed-sore exposing the whole length of the sacrum. The bones and ligaments of the spine in the other regions were carefully examined, but no trace of injury was discovered. Opposite the fifth and sixth dorsal vertebræ the cord was softened through all the columns into a thick, greenish, muco-puriform fluid, with a tinge of brown. Examined by the microscope, it was seen to consist of disintegrated nerve-tissue, with a few irregular collections of granules. *The cord was not enlarged at the softened part, nor was there any trace of inflammatory exudation in it or upon the membranes covering it,* though to the unassisted eye it had the appearance of an irregular undefined abscess. The lumbar and cervical portions of the cord had the normal appearance and firmness. A large portion of the lower lobe of the right lung and half the upper lobe of the left were hepatized. Heart normal. Liver large and fatty. Commencing suppuration in the cortical substance of the kidneys. Mucous membrane of the pelves greenish, with patches of adherent fibrinous exudation. This condition of the mucous membrane was continued through the ureters into the bladder. The bladder contained a quantity of muco-purulent fluid.

Remarks.—This case shows that the substance of the cord may receive an injury through violent muscular exertion, whilst the surrounding textures escape. Why this should rather occur in the dorsal region is obvious; since the curve of the column is most marked and most variable, and the body of the cord is thinnest, at this part. It is a matter also of common clinical experience that the cord is very prone to softening in the dorsal region, from which we may, perhaps, infer that, in addition to its being here more subject to injury, it has a more feeble organization than the cervical and lumbar enlargements. The change in the cord was seen by the microscope to be due to mere disintegration. There was no evidence of any plastic exudation. The greenish and brownish tints of the softened part were probably due to blood-colouring matter. We may infer, from the quality of the local changes, which appear to have been quite passive, and from this slight coloration, that the immediate effect of the injury was upon the capillary circulation, leading to effusion of blood and consequent atrophy.

CASE XXIII.—*Concussion of the cord in the cervical region from direct violence; ecchymosis into posterior horn of gray matter on left side, also into anterior horn on right side and into the posterior columns; loss of sensation immediately after the accident, followed by hyperæsthesia; paralysis of legs, left arm, and sphincters. Death thirty-four hours from the accident.*

(*Reported by* Mr. BANKART.)

Joseph K—, æt. 33, a coal-porter, strong and healthy, was carrying a sack of coals on his back, down some cellar-stairs, when his foot slipped forwards from under him and he fell, the sack of coals falling upon him. On his admission, immediately after the accident, 3 p.m., June 22d, 1858, there was loss of motion of both legs and of the left arm. The sphincters were paralysed. There was entire loss of sensation in the left arm as high as the deltoid. The right arm he could move, and had perfect sensation in it. On examining the state of sensation in the lower extremities, it was found that he could feel about the feet and on the outer side of thighs, but not on the anterior and inner surface. During the time marks were being made on the skin to indicate the state of the sensation at different parts, it was found to vary, returning to spots where it had just previously been absent. Apparently the most distant parts recovered first. Slight priapism. Breathing diaphragmatic. After a few hours, sensation returned in every part. As the skin became warm, he complained of pain when lightly touched. For instance, when the finger-nail was passed but lightly along the skin he would exclaim, "Don't prick me; don't hurt me!" The day following, the sensibility of the surface appeared to be excessive, judging by his exclamations when the skin was touched or pinched. This was especially noticed in the right arm. Priapism, which existed when he was admitted, passed off after two hours, but returned the day following. He continued to have power to move the right arm. He died thirty-four hours from the accident.

Post-mortem examination.—The spine only was examined. There was no external trace of the injury; no displacement of the vertebræ discoverable by external examination. The membranes of the cord were healthy. Opposite the fourth and fifth cervical vertebræ the substance of the cord was contused. On section, there was found ecchymosis of the posterior horn of gray matter on the left side, and of the adjacent part of the lateral and posterior columns. There were also other limited spots of ecchymosis on the right side, one in the right posterior column, and one in the anterior cornua of the gray substance. The gray matter generally was hyperæmic (from venous congestion?), but there was no other lesion of it, except

at the two spots named; no lesion of the anterior columns. The commissure was uninjured. On examining the spinal canal after the removal of the cord, nothing abnormal was discoverable in the bodies of the vertebræ opposite the lesion of the cord; but on dissecting off the posterior ligament it was seen that the body of the fourth was separated from that of the fifth, and that the left articular process of the fourth had been chipped off by the violent pressure of the lower one against it.

Remarks.—There are several points worthy of note in this case; the character of the injury received by the cord, namely, limited capillary ecchymosis; the absence of any external sign of the injury; the mode by which the cord was injured, namely, by concussion, and not by pressure of surrounding parts upon it, as shown by the ecchymosis being in the substance of the cord, whilst its peripheral parts and membranes had escaped; the limitation of the injury, producing paralysis of the left arm, whilst the right retained the power of motion; the immediate effects of the concussion on the cord, producing anæsthesia for a few hours; the return of sensibility first in the parts most distant from the injury, and the development of hyperæsthesia. This latter symptom was in accordance with the experiments of Séquard, who has shown that injury of the posterior cornua of the gray matter is followed by hyperæsthesia of parts below. Cases of injury, as before remarked, have as much interest to the physician as to the surgeon, since they often come under the care of the physician for the treatment of the permanent effects; when it is necessary there should be a correct estimate of the character of the primary lesion.

Case xxiv.—*Concussion of the cord by a fall; recovery of power after two hours. Subsequent effusion of blood outside the theca vertebralis in the neck. Paraplegia of upper and lower extremities. Paralysis of intercostals. Intense heat of skin. Death in fifty-five hours.*

(*Reported by* Mr. Venour.)

Robert L—, æt. 40, fell backwards from a moderate height, a heavy plank falling at the same time upon him. He was at once brought to the hospital (4 p.m., July 7th, 1858). He was collapsed, but sensible. There was entire paralysis of the left leg, partial of the right, and also partial paralysis of the arms, but he was still able to flex the fingers. After two hours he had so far recovered from the immediate effects of the injury, that he could draw up his legs and grasp the hand; the circulation was improved; surface warmer. No injury of spine discoverable. At 10 p.m. he said he felt comfortable. He passed a restless night, and the following morning, at 8 a.m., was entirely paraplegic both in the upper and lower extremities. Loss of sensation in the paralysed parts. Priapism. Ribs scarcely moved in inspiration. Temperature of surface increased. Abdomen tense and tympanitic. During the day the skin became intensely hot, but the actual temperature was not noted. The breathing was wholly diaphragmatic. Deglutition difficult. He died fifty-five hours from the accident.

Post-mortem examination, by Mr. Bryant.—No external evidence of injury to the spine. On dividing the soft parts, there was found a separation between the fourth and fifth cervical spinous processes, and dislocation of the articular processes. The inter-spinous and capsular ligaments were torn through. Extravasation of blood outside the theca vertebralis on its anterior aspect. The effused blood compressed the cord, which was otherwise uninjured. After careful examination there were not found any signs of bruising of its tissue. The extravasation apparently arose from injury to the lower part of the body of the fourth vertebra, which had been fractured, and the inter-vertebral substance torn. The calibre of the canal was slightly encroached upon by displacement of the fourth vertebra, but not so as to press on the cord. The extravasation, though most abundant opposite the injury, extended downwards to some distance. The membranes of the cord were uninjured.

CASE XXV.—*Cervical paraplegia following an injury. Progressive muscular atrophy of the upper extremities, most marked on the side of the principal lesion in the cord. Anæsthesia, with severe neuralgic pains on the opposite side. Paroxysms of hiccup for several months. Thickening and adhesions of the membranes of the cord. Degeneration of the posterior columns. Dilatation of the ventricle of the cord. Opacity and fatty generation of the arachnoid of the brain. Ependyma of ventricles granular.*

John G—, æt. 49, a coal-waggoner, was forced backwards from his seat by striking his head against a beam, whilst driving under an archway. Several ribs were fractured on the left side. Some months after this acccident he began to suffer pain from the occiput down over the shoulders, and in about a year the muscles of the upper extremities began to waste. After two years, incontinence of urine gradually came on. He was admitted into Guy's Hospital February 11th, 1857, three years from the time of the accident. He then presented a remarkable example of muscular atrophy without actual paralysis. The upper extremities were principally affected. The extensors of the right hand, the muscles of the thumb, and the interossei, were extremely wasted. The wrist dropped. The muscles of the shoulder and arm, including the pectoralis major and minor, much wasted, but in a marked degree less so than those of the forearm and hand. Very slight diminution of sensation. He could still lift the arm over the head. The left arm was similarly, but less affected than the right, so far as regards muscular atrophy, but there was numbness through the whole arm down to the fingers, and he suffered severely from neuralgic pains in it, which greatly depressed him, and which he described as a compound of smarting and numbness. The trapezii, serrati postici superiores, rhomboidei, and all the long muscles of the neck and back, were remarkably atrophied. The spinous processes were very prominent. No deformity nor tenderness on pressure at any point. The intercostals were so weak that the only respiratory movement was through the diaphragm. The supra spinati were atrophied, but not to the same extent as the infra spinati and levatores anguli scapulæ. The legs were wasted and weak, but he was able to walk. Sphincters weak. Dribbling of urine. Constipation. The thorax looked narrow and ill developed, from the wasting of the pectorals, the intercostals, and erectores spinæ muscles. The muscles at the back of the neck and the sterno-mastoids were so weak, that the head could not be supported erect. Sight dim, drooping of left eyelid. Frequent hiccup for many months. After his admission his principal complaint was of pain in the left arm from the clavicle to the fingers. He described it as a severe smarting, with a sense of numbness. His distress from this cause was very great. At the early part of March febrile symptoms set in. Tongue became dry and brown. Frequent hiccup and vomiting. Pain in left arm severe. Dyspnœa. Died March 25th, 1857.

Post-mortem examination.—The arachnoid of the brain

opalescent, with spots of white mottling of the more opaque parts from fatty degeneration. Subarachnoid fluid in excess. Ependyma of lateral and fourth ventricles granular, in the latter extremely so. The dura mater on the posterior surface of the cord much thickened. The two layers of arachnoid adherent in patches along this surface, and much thickened by effusion of lymph of old date. Sections of the cord examined with the naked eye gave no distinct evidence of disease. There was a slight yellowishness of the posterior columns, and increased vascularity and thickening of the pia mater covering them. In these columns, especially in the right one, abundance of granule-cells were discovered by the microscope. The exudation was greatest in the middle and lower third of the cervical enlargement. The gray matter was hyperæmic. No exudation into its tissue, nor into the anterior columns. The ventricle of the cord enlarged and distended with delicate granular nuclei. The affection of the cord appeared to be secondary to chronic inflammation of the membranes, and to chronic changes in the ependyma of the ventricle in common with the ependyma of the fourth and lateral ventricles of the brain. Hypostatic engorgement of both lungs, several lobules consolidated from recent pneumonia, some grayish. Other organs healthy.

Case xxvi.—*Progressive atrophy of the muscles of the trunk and upper extremities, after a blow on the neck with the fist.*

Daniel C—, æt. 15, received a blow with the fist between the shoulders from a boy at play. After a week the head drooped, and gradually from that time the muscles of the upper extremities wasted, the arms dropped and hung useless, the intercostals lost their power, and the breathing was diaphragmatic; the lower two thirds of the trapezii and the erector spinæ muscles also wasted in the same way. This sketch was made fourteen months from the injury, to exhibit the wasted condition of the muscles and the position of the head and trunk; the head fallen forwards and the trunk thrown backwards to balance it, in the absence of muscular power.

The flattening of the ribs from the paralysis of the intercostals was such that the heart beat to the right of the left nipple and between the third and fourth ribs.

The patient was able to walk about when the sketch was taken. His gait was vacillating, but apparently more from want of muscular power to fix the trunk on the pelvis than from defective power in the legs. He could not sit on a seat without a support to the back. Sphincters good. On testing the electro-contractility of the

Fig. 2.

wasted muscles, by galvanism, they were found to contract in proportion to their mass; those muscles of the upper arm, which were the less wasted, contracted well; those of the forearm and hand, which were the more wasted, contracted less, but still distinctly. The progress of the disease was unattended with any pain. The wasted muscles not tender. No flickering contractions of their fibres.

Remarks.—This case is recorded as a good illustration of progressive muscular atrophy after concussion of the cord. It is to be observed, that there was no more paralysis than was due to atrophy of the muscles, and that the electro-contractility of the muscles was in proportion to their bulk. These facts are of importance, since it has been erroneously proposed to determine by the test of galvanism the diagnosis between progressive muscular atrophy from morbid changes primarily in the muscles, and that muscular wasting which is consecutive to disease of the cord. It is said that, in the latter case, the muscles early lose their electro-contractility, a statement at variance with extended clinical observation, and further illustrated in Case XIX. No doubt, as the lesion of the cord advances in this case (which is still under treatment), the lower extremities will undergo the same changes as the

Fig. 2. Sketch showing wasting of muscles after a blow on the neck.

upper. A precisely similar instance (Case xv, with post-mortem examination), was recorded in the 'Reports' for 1857.

CASE XXVII.—*Acute rheumatic* (?) *affection of the larger joints. Paraplegia of lower extremities. Slough over sacrum. Recovery.*

Anne E—, æt. 39, was admitted into Guy's Hospital, March 31st, 1857, under the care of my colleagues, Dr. Hughes and Dr. Wilks (to whom I am indebted for placing the case at my disposal). Both hands were swollen, stiff, and painful, with an erythematous blush over the back of the right, and on the second joint of the thumb of the left. The legs were so far paralysed that she could only very slowly and feebly move them. The muscles were greatly wasted and flabby, but had not lost their excito-contractility by galvanism. Sphincters weak. No swelling of the knees or ankles at this time. Sensation nearly normal, but at times both legs felt numb, and were drawn up involuntarily. Urine acid, high coloured, and scanty. Tongue covered with a cream-like fur; skin hot, perspiration profuse, with acid smell. Pulse 120; systolic murmur over ventricle. On examining the spine, the lower third of the sacrum was found to be bent forward, the result of a fall eleven years before; and near the sacral notch, on the right side, was the cicatrix of a wound which formed at that time. Except this, there was nothing abnormal, nor any pain or tenderness on pressure. The history she gave of her case was, that being a widow, she was necessitated to work laboriously at a mangle. She had for two years, when much exerting herself, felt pain in the back between the shoulders, and a sense of constriction and coldness round the chest. Ten days before coming into the hospital she was seized with pain in the left leg, and had spasmodic contraction of the muscles, with an increase of the pain, and constriction round the chest. She had still power to extend the leg, but could not walk. The day following, the hands, knees, and ankles were swollen and painful. With these symptoms there was febrile heat and diarrhœa. The sphincter ani was so weak that the feces ran from her involuntarily. On the third day a slough formed over the sacrum. No important change occurred in her symptoms after her admission. There was great muscular emaciation generally. Involuntary twitchings of the muscles of the arms and legs. Aching, gnawing sensations in both calves. Touching the feet gave rise to formication, and very lively excito-motor movements. For ten days the hands remained red, painful, stiff, and swollen. She complained much of heat and profuse perspirations, which returned several times in the twenty-four hours. On the 8th of April the urine was ammoniacal, and contained mucus. The hands were still swollen and erythematous; face flushed; pulse 100, full, as in rheumatism; acid smell of perspiration; respiration 28; movements thoracic and abdominal; abdomen soft; pupils large; nights sleepless. Ordered a grain of opium every six hours, with six ounces of wine daily, and a chop. On April 13th the good effects of the opium and support were very apparent. The patient had passed good nights, and was tranquil in the day. Perspiration lessened. Urine retained in the bladder for thirty-six hours was at length passed voluntarily; it was acid, and without mucus. Tongue pale and moist. The slough on the back had deepened. The pupil still continued large. Occasional contraction of the muscles of the legs. No permanent rigidity.

Hands remained swollen and stiff, but less red. She was unable to move the shoulders freely. On April 22d the hands had recovered their normal appearance, and had lost their stiffness. The legs could be moved more freely. The sense of constriction round the chest was gone; pulse 96; skin cool and dry; appetite good; urine normal, but she could not empty the bladder oftener than once in twenty-four hours. From this date she slowly recovered. The opium was continued throughout her convalescence. At the beginning of June the muscles of the lower extremities were galvanized regularly. By the end of the month she was able to stand without help. Her improvement was uninterrupted, and, in September, she left the hospital quite well.

Remarks.—It is a matter of great clinical interest that lesions of the cord are occasionally attended with an affection of the joints not to be readily distinguished from that which occurs in acute rheumatism. When this happens there may be difficulty in determining the pathology of a case. It may, indeed, be impossible to say whether the symptoms at a certain stage are due to disease of the cord, or to a rheumatic state of the blood. In such instances we have a proof of the near relations of humoralism and solidism; for one observer may maintain that the local lesions have a common origin in the altered state of the blood, whilst another may with equal confidence assert their dependence upon a primary disturbance of the nervous centres. The case here recorded is an example of these difficulties. Fatigue from mechanical labour, acting especially on the lumbar and dorsal portions of the spine in a delicate and anxious subject, appears to have injured the nutrition of the cord. For two years, when much exerting herself, the patient felt pain between the shoulders, and a sense of constriction and coldness round the chest. Paraplegia then suddenly came on, followed by redness, pain, and swelling of the larger joints, as in rheumatism. Together with these symptoms, there were others indicating a rheumatic condition—white, furred tongue; flushed face; hot skin; profuse perspirations, having an acid smell; systolic murmur over left ventricle, &c. Was there here a rheumatic state of the blood induced by the spinal lesion; or was the nervous derangement the result of a rheumatic state? Notwithstanding the labours of morbid anatomists and chemical pathologists, we are not at present in possession of any certain knowledge of what constitutes the rheumatic condition. My colleague Dr. Addison, from his clinical experience, has long drawn attention to the

close connexion between spinal lesions and true rheumatism, but has never developed the idea beyond expressing a suspicion of their relation.

At the time this case was under care the treatment was a subject of much observation. The result was very satisfactory. Whatever might have been the state of the cord, it was clearly induced by fatigue, and was soon followed by sloughing of the integuments. It would not, therefore, admit of depletory measures, but, on the contrary, required a nutritious diet, and wine. Opium was prescribed apparently with great advantage; it allayed nervous irritability, and gave the patient sleep.

The following case is also illustrative of the relation between spinal injury and rheumatic symptoms. The same plan of treatment as above was equally successful. The therapeutical view of this subject is certainly not without the greatest interest. No doubt the texture of the cord has but feeble reparative powers, notwithstanding it has been shown by experimenters on animals, that occasionally, after a transverse section, the parts unite, and the functions are re-established.

Case xxviii.—*Concussion of the spine; partial paraplegia; redness and swelling of the wrists and ankles as in acute rheumatism. Recovery.*

W. T—, æt. 38, on the 22d January, 1855, inadvertently stepped backwards into a hole, a few feet deep, and received a concussion of the spine. After a few days he became partially paraplegic, with weak sphincters; and at the same time there came on a diffused redness and swelling of the ankles and wrists. The swelling was not from effusion into the joints, but from œdema of the surrounding tissues. The joints were very painful. The redness and swelling were variable in degree. When most marked they presented the usual appearances of rheumatism, or rather of gout, for the erythema was brighter, and the œdema more distinct than in rheumatism. The hands were equally affected with the ankles, though there was no obvious want of muscular power, nor any affection of sensation in the upper extremities. Tongue clean. Pulse 120. No acid perspirations. Urine high coloured, free from deposits; of normal quantity. The nerves of the surface generally were hyperæsthetic to a slight touch, but deep pressure gave less inconvenience. The treatment consisted of good nourishment, wine and brandy freely administered, and opium to allay pain and overcome sleeplessness. The pulse gradually acquired more power, and sank to 80. The affection of the joints continued in varying degree through March, April, May, and June. From the beginning of April there was an improvement in the power over the legs. The same treatment was continued throughout without the use of mercu-

rials, local depletion, or counter-irritation. In June, the patient was able to walk without assistance. During sleep, the hands and feet, wrists and ankles, often became erythematous and swollen. There was occasional formication in the lower extremities. Sleeplessness, from the beginning of the case, and throughout was a troublesome symptom. In July, the patient was able to leave the hospital, and to resume to some extent his duties as a medical practitioner. He was under the care of my colleague Mr. Cock.

CASE XXIX (Plate IV, figs. A, B, C).—*Anæsthesia of left arm without any other symptom. After three years, gradual loss of muscular power in the arm, with wasting of the muscles; subsequently, a similar affection of the right arm, but in a less degree. Death from general paraplegia at the end of five years from a fall, by which the anterior columns of the cord were ruptured in the lumbar region. Thickening and adhesions of the meninges, especially in the cervical region of the cord; atrophy of the posterior columns, of the posterior roots of the nerves, and of the gray substance, with a development of fibrous tissue.*

Mary S—, æt. 38, a nurse in Guy's Hospital, complained in 1853 of anæsthesia of the left arm, which had come on gradually for nearly a year. There appeared to be entire loss of feeling below the elbow, but, on testing the sensibility upwards to the shoulder and over the scapula, she gave vague and often contradictory answers, at one time affirming, and at another denying, that she perceived impressions made upon the same points of the skin. This discrepancy was perplexing, and led at the time to the belief that her ailment was either feigned or hysterical. The sensibility at the upper part of the thorax, in the axilla, and at the inner part of the arm, was perfect. The muscles were well nourished, the movements powerful and well directed; but the anæsthesia was so complete, that she was unable to hold anything in the hand if her eyes were off it. She often complained of gnawing pains extending down the back, across the shoulders, and into the left shoulder-joint; these pains were increased by the changes of weather. Her symptoms continued unaltered for two years. The following note was made of her case in December, 1855: "Complete anæsthesia limited to the left arm, no wasting of the muscles, no affection of the leg on the same side, general health in all respects good. Electro-contractility of the muscles of the affected arm good. Electro-sensibility greatly diminished. During the next two years there was gradual loss of power, principally in the left shoulder, but also generally throughout the arm, with marked wasting of the muscles. The right arm became at the same time similarly affected, but in a much less degree. She walked quickly, but with a shuffling gait. The left leg was dragged. She was unable to lift the arms over her head, or to extend them horizontally, but when they hung down she could grasp with tolerable firmness and carry heavy weights. She continued to make frequent complaint of pain in the arms and down the back, and of a feeling of weight at the epigastrium. Her manner was often excited, her nights restless, and she was subject to attacks of tremulousness and chilliness like ague, with a sense of

general numbness. About the middle of December, 1857, she accidentally fell forwards upon the stone steps of the hospital, from stepping upon her dress whilst assisting a patient into a cab. Her left temple was cut, and she was rendered insensible by the fall. On recovering consciousness, a short time afterwards, the legs were found to be quite paralysed, and there was almost entire loss of sensation. The weakness of the arms was greatly increased. There was entire loss of sensation below the elbows, and but feeble traces of sensibility above. The muscles were also much wasted. After the accident, the urine became ammoniacal and contained pus. The skin over the sacrum rapidly sloughed, and she died exhausted at the end of a month.

Post-mortem examination.—General wasting of the muscular system. Lateral ventricles of brain dilated and containing clear fluid. The septum lucidum perforated in many places from atrophy. No disease of the bones or ligaments of the spine. The dura mater of the cord was much thickened, apparently by chronic inflammation. This thickening was most marked at the lower part of the cervical enlargement, and along its posterior surface (Plate IV, B, C). In the dorsal region there were plates of true bone, formed by ossific degeneration of the inner layers of the thickened dura mater. One of these plates opposite the third dorsal vertebra was half an inch in length, a third of an inch in width, and a line and a half thick. As these plates were developed by degeneration of the layers of the fibrous membrane, they merely enveloped the cord without producing any pressure upon it. The arachnoid was thickened and opaque, and the two surfaces adherent. In the visceral layer in the lumbar region, several cartilaginous (fibrous) plates. These changes were most marked in the neck, but were continuous down to the cauda equina. The texture of the cord itself had undergone important changes, as shown in Plate IV. About half an inch below the medulla oblongata, on the left side, there was a cyst occupying the position of the gray matter. Its walls consisted of fibrous tissue and compressed nerve-tissue. There was a similar, but smaller cyst, on the right side, at a lower level. No more than a trace of it comes into view in the section drawn (fig. A). The cysts contained colourless limpid fluid. At the cervical enlargement, as seen at A, B, the posterior columns and the gray matter were extremely degenerated. They consisted of some remains of the columns, imbedded in a stroma of fibrous tissue. The posterior roots of the spinal

nerves were included in the degeneration, and the sheaths were thickened in common with the surrounding membranes. The section at B shows this. The lower section at C did not happen to include the nerve-roots, though the same conditions obtained. The anterior columns and portions of the antero-lateral columns were normal, except in the dorsal region, where the anterior columns were ruptured transversely across, apparently at a recent date, and probably by the fall which brought on the fatal symptoms. Viscera of chest healthy. Liver healthy. Acute suppuration of both kidneys; the secreting tissue full of small purulent deposits. Mucous membrane of the pelves dark coloured and covered with fibrinous exudation. Bladder acutely inflamed; the mucous membrane had sloughed away, scarcely a shred was left on the muscular coat.

Remarks.—The error committed in the early diagnosis of this case was one likely to happen; especially as the patient was a woman. She complained of numbness of the arm. There was nothing visibly wrong with it on the closest examination. The muscles were well developed, the movements were normal, and so were the circulation and temperature. Beside her own account of the numbness there was nothing to indicate disease of the cord or nerves. Her statement, that if she took her eyes off anything held in the hand forthwith she dropped it, was the only circumstance which appeared at the time to have any value as a symptom, and even this was lessened by testing the sensibility. When the patient's head was turned away and she was unable to see what was done, the point of a needle was passed sharply over different parts of the arm. Below the elbow there was an uniform testimony to the absence of all feeling, but upwards there was every kind of contradiction. When she denied feeling at a part, a minus sign was put on it with a pen; when she affirmed it, a plus sign was marked. After mapping out the skin with plus and minus signs, the parts were again tested, and with contradictory results; the plus signs fell over the minus spots, and the minus signs over the spots before marked with plus signs—and so on, in the most uncertain way as often as the trial was repeated. This led to a hasty and false conclusion that the patient was feigning, or that her malady was the vagary of an hys-

terical state. Further clinical observation in other cases, and the examination of the cord in this, have elucidated what was at its early stage so bewildering. When the sensibility of a part is obscure or doubtful, the testimony of the individual as to impressions made upon it may be also doubtful. The same occurs to us with our healthy sensibilities when, conversely, weak impressions are made upon us. When we look at an object scarcely visible, at one moment it appears, and the next is lost. There is in our minds the same discrepancy as to whether we see it or not, as this patient manifested when asked whether she felt or not. Her contradictions were a proof of the obscurity of her sensations, and her convictions fluctuated between certainty and uncertainty, no doubt because the evidence was to her equivocal.

The lesion began apparently in the membranes, and thence extended to the cord, implicating the sensitive roots of the nerves.

There was no history of any acute invasion, nor did the symptoms at any period indicate acute disease.

The dura mater of the brain occasionally offers a similar form of chronic thickening. Though the morbid change must be referred to inflammatory action, the process must have been most gradual; so gradual indeed, that the symptoms were only such as were referrible to atrophy, although the exudation thickened the membranes, and infiltrated the posterior columns. There was no rigidity or other form of spasmodic affection of the muscles, as might have been expected in spinal meningitis.

Whether the exciting cause of the meningeal inflammation was injury, exposure to cold, or a rheumatic condition of the blood, is uncertain. There was no change in the pericardium or valves to corroborate the opinion of its being rheumatic. But, whatever the original cause, its course would be determined by the diathesis of the patient; and hence, in the treatment of such a case, we must determine not only the seat and character of the local lesion, but also view it through the peculiarities of the constitution, whether gouty, rheumatic, scrofulous, or syphilitic. Unless we approach accuracy of diagnosis in both these respects, the therapeutics of the case may be no better directed than the efforts of an engineer, who should

pour medicine down the funnel of his engine, because the power fails in the piston.

It is probable, that at any early period, this case would have been benefited by repeated blisters, and the continued mild use of mercury and iodide of potassium.

The fatal accident was peculiar. The adhesions of the membranes prevented the movements of the cord in the sheath, and exposed it to stretching by any sudden motion of the spine.

The sections of the cord (Plate IV) show to what extent disorganization may take place, and yet the cord serve as a conductor of the voluntary power. The changes at A, B, C, must have been present at the time of the accident, when the patient was able to walk about quickly, and with no more than a shuffling gait, and some dragging of the leg.

CASE XXX.—*Pain in back and loins for a year. Profuse hæmaturia, followed after a month by weakness of the legs, which gradually increased to complete paraplegia. Malignant disease of lumbar glands and of the right kidney, extending into the bodies of the vertebræ, and causing sloughing of the cord.*

Mrs. W—, æt. 58, a poor needle-woman, overworked, and but scantily fed, was admitted into Guy's Hospital, December 5th, 1857, under the care of Dr. Wilks, for partial paraplegia of the lower extremities. She had been confined to her bed for eight weeks. There was emaciation of the whole body, but especially of the muscles of the legs, which were loose and flabby. She was just able to stand, but not to walk. The back was straight. No abnormal protrusion of any of the spines of the vertebræ. For a year she had had great pain across the loins and back, with some indefinite tenderness. This was at first supposed to be due to her sedentary habits, and then to rheumatism. A month before her legs began to fail her she had profuse hæmaturia, which was thought to arise from calculus in the kidney. After her admission into the hospital the paraplegia gradually became complete, without any preceding rigidity or involuntary jactitation of the legs. The integuments over the sacrum sloughed, and a similar tendency was manifested over the sides of the knees, from one leg resting on the other. She died exhausted January 20th, 1858.

Post-mortem examination.—The outside of the theca vertebralis was covered with a thin layer of grayish offensive pus. The last dorsal and the three upper lumbar vertebræ were infiltrated with cancer extending from the lumbar glands. The body of the first lumbar vertebra was sloughing. The slough-

ing process had thence extended to the adjacent portion of the theca vertebralis, and to the body of the cord, which was ash-coloured, and entirely disintegrated, from the eighth lumbar vertebra, to the filum terminale. Several broad cartilaginous laminæ in the lumbar arachnoid. No inflammatory exudation within the theca. Above the eighth dorsal vertebra the cord was remarkably pale and flaccid. No discoverable exudation among the tissue. The right kidney was enlarged by cancerous deposit. Left kidney healthy. Uterus and liver healthy. Cancerous tubera on and under the pleura of both lungs, and cancerous deposit in some of the bronchial glands.

CASE XXXI.—*A wrench of the neck followed after six months by a "stitch" in the neck, supposed to be neuralgic. Extensive development of cancer about the upper dorsal vertebræ; throughout the right lung; up the back of the neck under the deep muscles; and inwards between the laminæ of the vertebræ. Paralysis of the arm and right leg. Softening of the cervical portion of the cord. Death sudden.*

Robert P—, æt. 34, a farm-labourer, was admitted under my care, August 5th, 1858, for paralysis of both arms and of the right leg. Intelligence perfect. The account he gave of his illness was, that six months previously he was taken with a "stitch" in the neck under the right ear. The pain "was so bad it almost crazed him." After a short time the pain extended to the left side of the neck towards the occiput, and thence downwards between the shoulders into both arms and into the legs. The pain under the left scapula was for a time very distressing. When he had suffered thus for four months, the left arm began to get numb and powerless from the shoulder downwards. He continued able to walk about very well until three weeks before his admission, when the right arm also and the legs began to fail him. The sphincters retained their power for a fortnight longer. On admission, both arms from the shoulders were powerless, but he could move the fingers slightly. Loss of sensation almost complete throughout both arms. Right leg paralysed, left moved with some freedom. Loss of sensation as high as the fourth intercostal space. Left chest uniformly enlarged and universally dull on percussion, including the sternal region. Heart displaced to the right side. Respiration performed entirely by the right lung. Diaphragm and ribs moving freely on this side. Movements of head and neck without pain. Spine straight. No pain in any part. Respiration 44. Pulse 120. The following day, August 6th, at eleven a.m., the breathing became much embarrassed, and he died quite suddenly at two p.m. After the post-mortem examination the friends gave an account of his having wrenched his neck about a year before in throwing hay into a loft.

Post-mortem examination.—The left chest equally distended,

and the heart displaced to the right side by the development of medullary cancer in the left lung. With the exception of a part of the centre of the lung, the pulmonary issue was entirely destroyed. The pleura was thickened and cancerous, and firmly adherent to the ribs. In the right lung there was a tumour of the size of an orange, having the usual characters of fungus hæmatodes. The cancerous growth had a firm attachment to the anterior part and sides of the body of the third dorsal vertebra, and extended upwards on both sides of the neck, under the deep muscles, as high as the third cervical, and inwards between the laminæ, so as to come in contact with the theca vertebralis. The theca was thickened, and the trunk of the fourth cervical nerve invaded on the left side. Unfortunately there was no opportunity to dissect the nerves of the brachial plexus, to determine their relations to the disease outside the vertebral canal. The cervical enlargement of the cord was swollen and softened, and granule-cells were scattered through its tissue. This change had apparently advanced into the cord from the right side of the neck. There was no cancerous deposit inside the theca vertebralis. The arachnoid had its normal appearance. It was the substance of the cord only which had begun to suffer from the proximity of the new growth. Head not examined. Viscera of abdomen healthy.

Case xxxii.—*Gradual loss of power in right arm, and subsequently in left; after two months and a half, partial paralysis of legs; breathing diaphragmatic; frequent vomiting; pulse quick and feeble. Death by exhaustion, after seven months. Strumous tubercle in the lower half of the cervical enlargement of the cord.*

Elizabeth W—, when eight months old, began gradually to lose the use of the right arm. After a fortnight the left became weak in a similar way. She came under my care as an out-patient at Guy's Hospital, April 13th, 1857, when the paralysis had lasted two months. The wasted arms then hung loose and useless. The head was retracted between the shoulders. The neck stiff. The legs were weak, but could be moved voluntarily. The muscular system generally was wasted, but of the arms most. The skin was constantly warm and freely perspiring. Occasional vomiting. Quick, very feeble pulse. A strumous swelling, the size of a small nut,

was noticed in the skin of the right arm. A distinct history of struma on the father's side. The diagnosis was of tubercular deposit in or about the cervical portion of the cord. At the early part of May the right knee became swollen from effusion into the synovial membrane, and from this date both legs became partially paralysed. There were frequent spasmodic contractions in both legs, but most in the right, which was the weaker. In June the breathing was hurried and entirely diaphragmatic. Vomiting frequent. Difficult deglutition. Diarrhœa. During June and July vomiting and diarrhœa continued. There was great heat of skin. Profuse perspirations. Ammoniacal urine. Pulse 140. Respiration 40. The long muscles of back became atrophied. Shoulders drawn up by the elevator muscles of the scapulæ. There still at this time remained traces of voluntary movements in the legs. She died September 12th from emaciation and exhaustion.

Post-mortem examination.—Only the cervical portion of the cord was allowed for examination. The surrounding structures were healthy. The cord itself, in the lower half of the cervical enlargement, opposite the origin of the sixth and seventh cervical nerves, appeared to be enlarged. This enlargement arose from the presence of a strumous tubercle, which at this part had caused complete absorption of the proper tissue of the cord. This formation seemed to have had its origin in the right posterior and postero-lateral columns, thence extending by successive deposits, until the cord was gradually destroyed, only slight traces of the anterior columns remaining where the tubercle was largest. The chief part of the tumour, from the centre outwards, was opaque, yellow, and friable; it consisted of granules, decaying nuclei, cells, and fat. This opaque dead part was surrounded by a transparent thin layer of more recent exudation, consisting of granules, nuclei, and imperfect fibre-cells, with no free oil-globules. Above the tubercle, the two layers of arachnoid were firmly adherent, and by contraction had constricted the cord. Just below the tubercle, the substance of the cord was so soft that it did not retain its form when unsupported by the membranes.

Remarks.—The gradual onset of the paralysis in this case, and its gradual extension until both arms became paralysed, obviously indicated a progressive organic change in the cord. The nature of this change was also to be plainly inferred from the hereditary tendencies through the father's side, and from the actual presence of a strumous formation in the arm.

That during the earlier stages of its course the disease should have been one of cervical paraplegia, the power over

the lower extremities continuing after the arms were paralysed, accords with what has been noticed in other cases, but when instead of central disease, the lesion primarily affects the external parts of the cord, at least of the anterior columns, the legs suffer first, and often exclusively if the lesion be moderate.

It is a matter of regret that the state of the sensibility of the legs was not determined. Perhaps, from the age of the child, it could not have been determined.

Plate I.

To illustrate Dr. Gull's cases of Paraplegia.

Transverse section of the spinal cord in the dorsal region (Case xviii), showing atrophy of the gray substance, and inflammatory degeneration of the columns ($\times$ 12.)

The atrophy did not affect the caudate vesicles. These, by a higher power, were seen to have their normal structure. The white substance was symmetrically degenerated from chronic inflammation. The exudation cells had undergone fatty degeneration, and were incrusted with fat-globules. The capillaries are seen to be similarly incrusted, producing irregular white lines. The symmetry of the lesion was very exact. It included a small portion of the anterior columns on either side of the anterior fissure, the posterior half of the lateral columns, and the centre and posterior portion of the posterior columns. The part of the posterior columns adjacent to the posterior horns of the gray substance was normal. There was no exudation amongst the gray substance. The apparent traces of such, seen in the drawing, are caudate vesicles.

The artist has not strictly drawn the granule-masses according to scale, but he has faithfully rendered the general appearance of the section under a low power.

Plate I.

T. Hurst. del.

Day & Son Lith. to The Queen

PLATE II.

To illustrate Dr. Gull's cases of Paraplegia.

Longitudinal section of the spinal cord in the dorsal region, from the same subject as Plate I ($\times$ 12).

The section was made behind the centre of the cord, so as to pass through the degenerated portions of the lateral columns and through the posterior columns.

As the section is not quite parallel to the axis of the cord, it is only at the lower part of the plate that the section of the posterior columns is shown. At the upper part the knife entered the posterior surface of the gray substance.

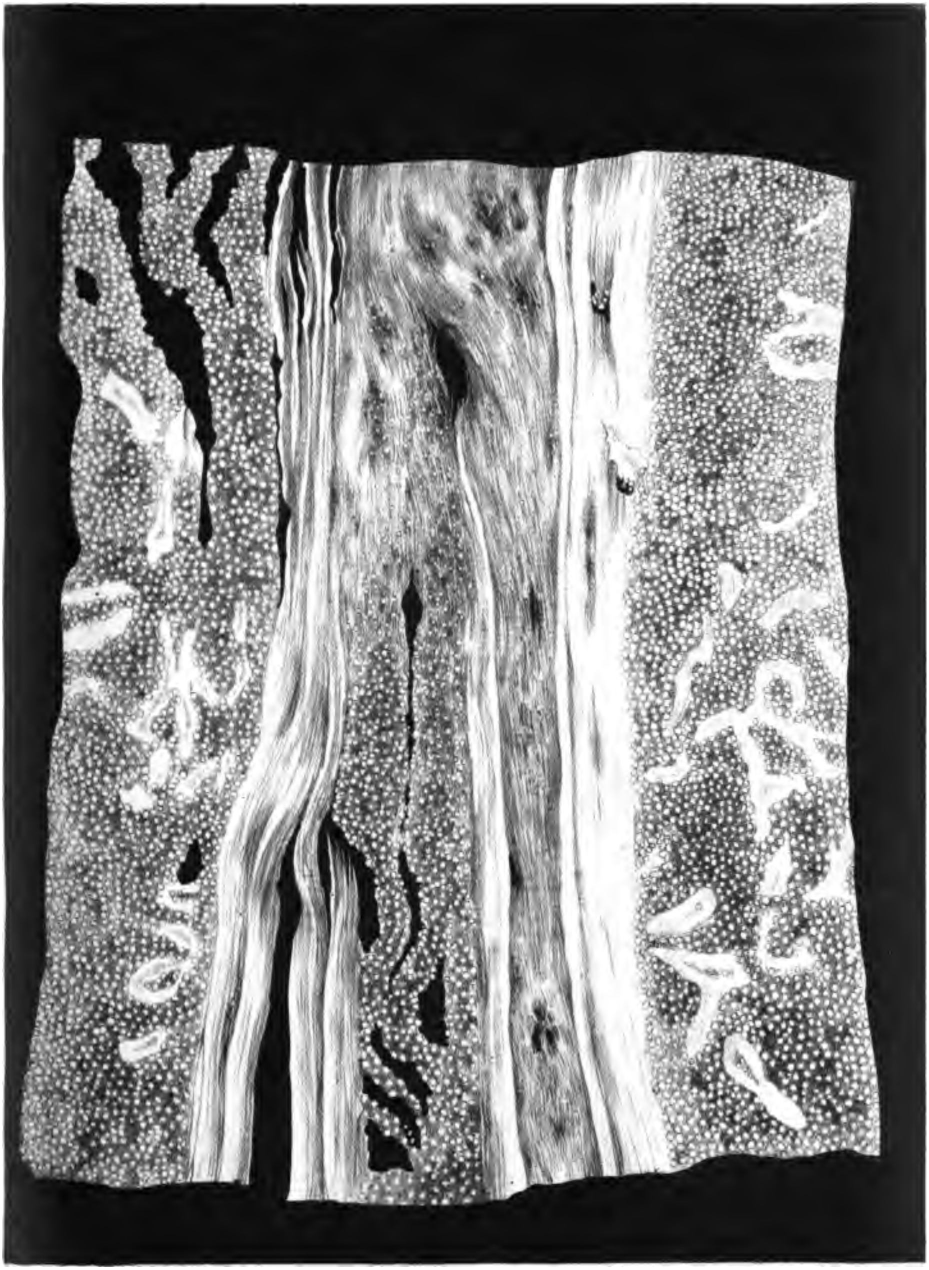
In placing the section on the slide, it was slightly torn and the parts displaced, but it was thought best that the artist should faithfully draw the section as put before him.

The degeneration of the lateral columns on the right and left of the section, and of the posterior columns in the centre, is but a repetition of that described in Plate I; but here the position of the exudation-cells amongst the tubules of the white substance was more distinct.

At the lower part of the section, on either side of the accidental fissure, it is seen how entirely the gray substance has escaped the exudation, and the same holds in the corresponding portion of gray substance on the right side; in this respect the lateral columns and the small portion of the posterior columns included in the section at the lower part of the plate present a remarkable contrast.

What appearance there is of exudation in the gray substance is due to the presence of normal caudate vesicles.

Plate II.



W. Hurst del.

Day & Son Lith^rs to The Queen

PLATE III.

To illustrate Dr. Gull's cases of Paraplegia.

Transverse section of the cord (Case XIX), showing degeneration of the posterior columns from chronic inflammation (× 9).

The anterior and antero-lateral columns, and the gray substance, were normal. The upper section in the plate (A) is from the upper cervical region; the lower (B) from the lower dorsal region. The granular appearance was due to fatty degeneration of the inflammatory exudation. Though the artist has exaggerated the relative size of the granules to the columns, for distinctness' sake, he has strictly maintained their relative distribution. The lesion was remarkable, from its being so entirely limited to the posterior columns, though it affected them throughout their own length.

Plate 3.

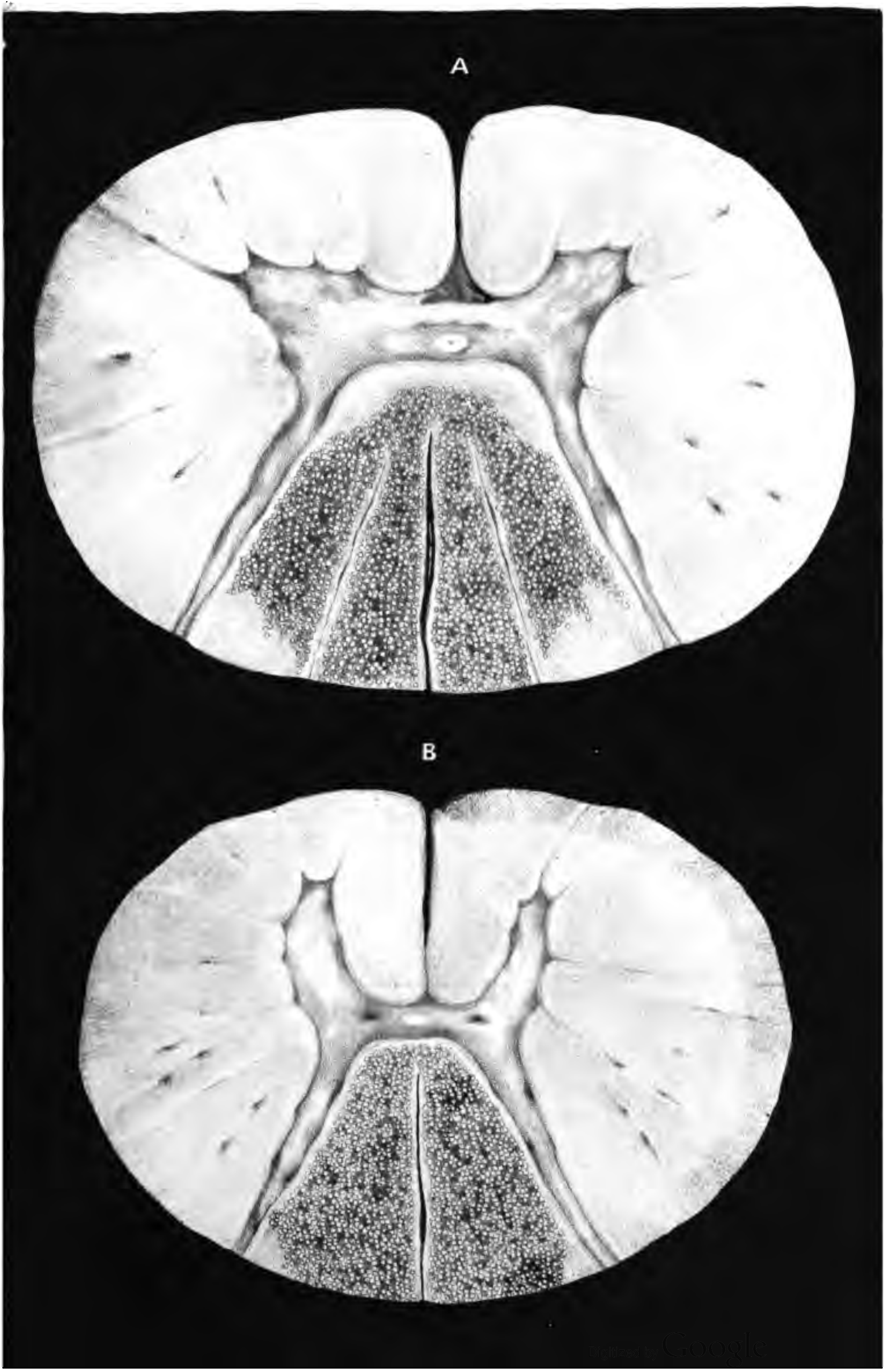


PLATE IV.

To illustrate Dr. Gull's cases of Paraplegia.

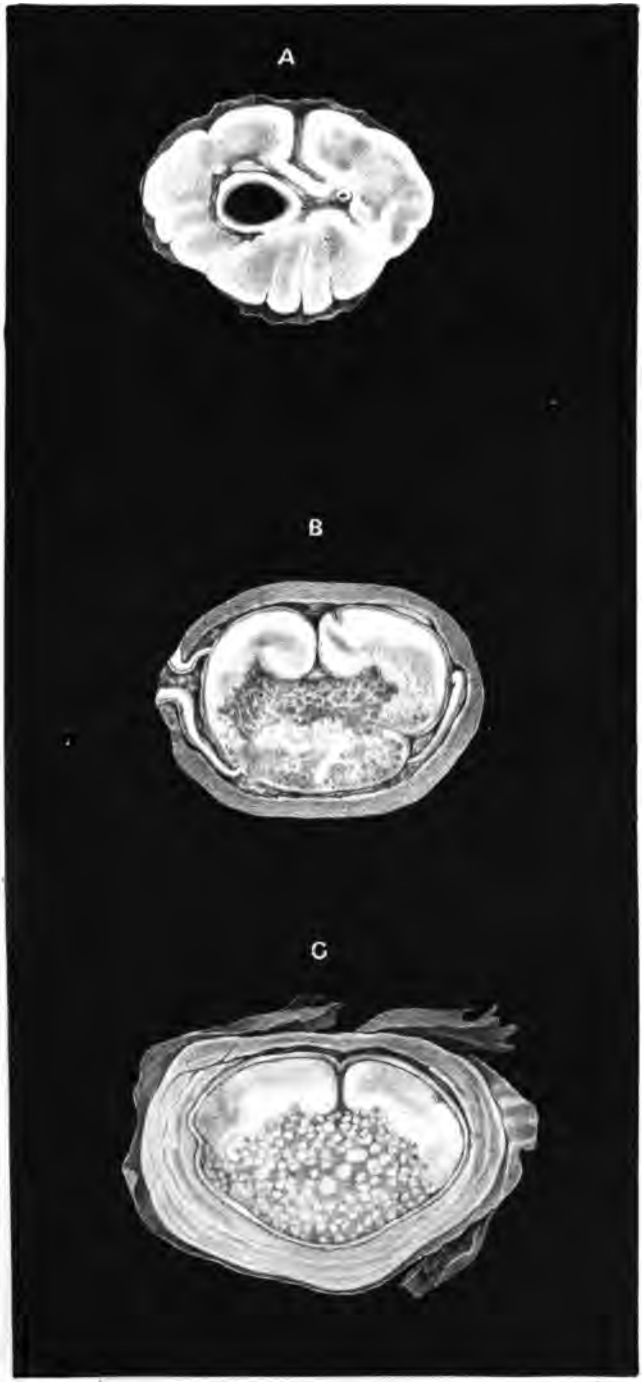
Transverse sections of the cord and its membranes, Case XXIX ($\times 2\frac{1}{2}$).

A. Section through upper part of the cervical region. The left side of the cord was here distorted by the development of a cyst in the gray substance. A smaller cyst of the same kind existed in the gray substance on the right side, but at a lower level, so that only a trace of it is visible in this section. These cysts had distinct walls of fibrous tissue and condensed nerve-substance. They contained clear colourless fluid.

B. Section through upper part of the cervical enlargement, showing great thickening of the membranes, and degeneration of the posterior columns and gray substance, including also the posterior roots of the nerves, with the development of common white fibrous tissue in place of the normal structures.

C. Section about the middle of the cervical enlargement. The membranes, and especially the dura mater, extremely thickened. This change was greatest on the posterior surface of the cord, where the membranes were adherent together. The posterior columns, the gray substance, and the posterior roots much degenerated. Some of the normal structure of the posterior columns is seen lying imbedded in a stroma of fibrous tissue.

These changes were due to chronic inflammation, apparently advancing from the membranes into the substance of the cord.



W. Hurst.

Day & Son, Lithʳˢ to the Queen

A CASE

OF

PHARYNGOTOMY

FOR THE

EXTRACTION OF A FOREIGN BODY.

WITH SOME REMARKS.

By EDWARD COCK.

About two years ago I succeeded in extracting, by the operation of pharyngotomy, a metallic tooth-plate which had been swallowed by the patient, and retained at the termination of the pharynx. A record of the case appeared at the time in the 'Medical Times and Gazette,' and in the 'Lancet,' and it was otherwise noticed. It was not, therefore, my intention to take any farther steps to bring the matter before the public.

As, however, the use and application of artificial teeth is daily on the increase, and is now universally adopted in all ranks and conditions: as, moreover, many of these succedanea are badly made, imperfectly fitted, and carelessly worn—there can be but little doubt that the casualty which induced me to perform a severe, and perhaps a dangerous operation, will occur again and again. The operation appears to have been one of great rarity, and I can find but very few cases recorded in which the pharynx and œsophagus have been

opened for the purpose of extracting a foreign body. A vast number of cases are on record of foreign bodies retained in the gullet. In some instances they have been extracted through the mouth, in others they have been pushed into the stomach, or the means employed having failed to produce either of these solutions of the difficulty, they have been left until some favorable process or fortunate effort of nature has got rid of the mischief; or else, as has frequently occurred, the patient has perished either from the retention of the body in the gullet, or from the violence which had been used to effect its dislodgement. In the 'Mémoires de l'Académie de Chirurgie,' will be found a most voluminous paper on this subject, detailing an infinity of instances both of successful and fatal results where a foreign body had been swallowed and retained in the gullet. But, although many perished under the ordeal at shorter or more lengthened periods after the accident, in no one single instance does any attempt appear to have been made or contemplated to cut into the pharynx or œsophagus, and relieve the patient. The operation has probably been considered more difficult of performance, more severe in its character, and more dangerous in its consequences than it really is; and I entertain but little doubt, that farther experience will teach us that, whenever an absolute necessity for its performance exists, it may be undertaken with a very fair prospect of success.

Directions for exposing and opening the gullet may be found in several books of operative surgery; but, generally speaking, they are vague and speculative in their character, and evidently not founded on the results of practical experience. With the assistance of Mr. Poland, I have obtained the records of seven cases in which the gullet has been opened to extract a foreign body. The history of these cases is interesting and important, as it serves to demonstrate, that the fatal result in two instances depended not so much on the operation itself, as on the delay in its application, coupled with the means which had been previously adopted to effect an extraction.[1]

It would appear, that more than a hundred years ago, in

[1] I find that all these cases have been brought together and recorded in the 'Medical Times and Gazette,' for the year 1856.

1738, M. Goursauld, a French surgeon, performed the operation of œsophagotomy, and extracted from the gullet of a man a portion of bone, an inch long and six lines broad. The patient recovered from the operation.

We also learn from the memoir of M. Begin, that a Mr. Roland was successful in removing a foreign body, probably a portion of bone, from the gullet of a patient by the operation of œsophagotomy.

The third case of œsophagotomy on record was performed by Mr. Arnott on the 21st of January, 1833, and a very interesting and instructive account of it will be found in the 'Medico-Chirurgical Transactions' of that year. A child two years and a half old, on December 16th, swallowed a portion of mutton bone, which became impacted in the pharynx, producing inability to swallow anything but fluids, but not giving rise to extreme distress. The bone could just be felt by the finger, but resisted the exhibition of emetics and various mechanical means to effect its withdrawal. Farther surgical interference was declined by the parents of the child, and it was not until five weeks after the accident, when distressing symptoms and oppressed breathing had developed themselves, that the operation of œsophagotomy was allowed and put into practice. The incision was made on the right side of the neck; the gullet was opened, and the spinous process of one of the lower dorsal vertebræ of a sheep extracted. The death of the child, which occurred fifty-six hours afterwards, was clearly attributable to pneumonia, which there can be no doubt existed at the time of the operation.

No traces of any mischief dependent on the wound were found, and there is every reason to believe that had the operation been performed earlier it would have been eminently successful.

In the year 1832 M. Begin had the satisfaction of performing the operation of œsophagotomy in two cases with perfect success; and has recorded his views on the subject, in an excellent memoir published in the eleventh volume of the 'Journal Hebdomedaire,' for 1838.

A soldier had swallowed a portion of beef bone, which stuck in the œsophagus, at the lower part of the neck. Various

attempts were made to dislodge it without success, and on the twelfth day after the accident, the operation was performed. Much difficulty was experienced, but the bone was eventually extracted, and the patient speedily recovered.

In the second case, M. Begin removed from the lower part of the cervical portion of the œsophagus a large fragment of bone of a conical shape, which had been swallowed by the patient eight days previously. Every means had been used to dislodge the foreign body, until the severity of the symptoms compelled the surgeon to have recourse to the knife. The man recovered, and resumed his duties.

In both these instances the incision was made on the left side of the neck.

In the year 1845 Dr. Martini incised the neck for the purpose of extracting a portion of bone which had been swallowed by the patient four days previously. The foreign body could be felt from the exterior projection above the clavicle, and the incision was made on that spot. It would seem, however, that the patient anticipated the intentions of the surgeon, and swallowed the bone before it could be seized and extracted. Death from collapse took place two days after. The pharynx was found in a gangrenous condition, and the stomach and duodenum were inflamed. The bone had passed into the rectum. There can, I think, be no doubt, that in this case the fatal result was brought about, not by the operation, but by the severe and somewhat extraordinary means which were previously used to dislodge the bone. When we read that the man was repeatedly bled, that sixty separate attempts at dislodgment were made with levers and forceps, that enemata of belladonna were employed, that, finally, tartar emetic was injected into the veins, followed up by clysters of vinegar and opium to counteract its effects; moreover that during this ordeal the patient was unable to swallow even a drop of water, it is not surprising that he finally succumbed.

In the year 1845, M. Delarocherie, Professor of Clinical Surgery at Liege, removed a large portion of bone from the gullet of a man by œsophagotomy.[1] The operation appears

[1] 'Journal de Chirurgie,' November, 1845, p. 337.

to have been performed on the eighth day after the accident, and not until the patient's life had been nearly compromised by the repeated and strenuous efforts made to dislodge the foreign body, giving rise to profuse bleeding and severe injury to the gullet, which from the narrative seems to have become ulcerated through its walls previous to the operation. The incision was made on the left side, and the operator was guided to the precise seat of mischief by seeing bubbles of air, and some water swallowed at the time escape at the bottom of the wound. The wound suppurated and sloughed; but the patient had recovered by the twenty-sixth day.

The account of the following operation, which I performed about two years ago, is taken almost verbatim from the report which appeared at the time in the 'Medical Times and Gazette,' care having been taken to correct several typographical mistakes, which had rendered the text in some places incorrect, in others unintelligible.

Mr. T. Guilford was brought to me on Thursday morning, January 17th, 1856, by Mr. Martin, of Dartford. It appeared that he had worn for some time a false central incisor tooth, fixed in a gold plate which extended some distance on either side. This—the foreign body which was subsequently cut out of the pharynx—may be thus described:

The plate formed the segment of a circle corresponding with the hard palate behind the incisor cuspidati and bicuspides teeth. The one extremity of the plate terminated in a slender clasp with two points as sharp as needles, which encircled the bicuspid tooth; while the other extremity formed a single sharp point.

The anterior convex edge of the plate presented three acute angular projections, corresponding with the interdental spaces, and from this margin also the false tooth formed a prominent projection. The extreme length of the plate, in other words, the *sector* of the circle was an inch and five-eighths; while a line drawn from the edge of the tooth to the sector, measured exactly one inch. This plate had been swallowed during sleep at about 2 o'clock a.m.; and Mr. Martin, finding that it had stuck in the gullet and could neither be seen nor felt from the mouth, brought him up to me from Dartford for farther advice.

There could be no doubt that the foreign body had lodged in the cervical portion of the swallow, but its exact situation was not very clearly indicated. The irritation, pain, and the tenderness on pressure, all of which were very considerable, were referred to the top of the œsophagus, just below the larynx; but no projection, indicating the precise locality of the plate, could be detected from the exterior. The patient was able to swallow fluids, although with great difficulty and in very small quantities. His breathing was not impeded, but he had an irritating laryngeal cough.

Under all the circumstances, I judged it most expedient to delay any active measures for extraction, until he had recovered from the immediate effects of the accident and the fatigue and excitement of his journey. He was therefore advised to go into the hospital in order that every available means might be used; and he willingly agreed to this arrangement. In the course of the afternoon I visited him, and passed a bougie into the pharynx, and found a total obstruction about the lower edge of the larynx; in fact, just at the junction of the pharynx and œsophagus. A pair of strongly-curved forceps detected the plate, but it could not be grasped, neither could it be moved from its position. As his respiration was unimpeded, and as the pain was quite bearable when he kept at rest, it was determined to postpone further measures until the next day. A full dose of opium was given, as much fluid nourishment as he could get down was ordered, and he was furnished with ice to suck at his leisure.

On Friday, January 18th, I saw him with Mr. Hilton. He was calm and tranquil, and did not suffer acutely, except when pressure was made from the exterior or when he attempted to swallow. It appeared very doubtful whether any fluid which he took into his mouth found its way into the œsophagus. Attempts were made with several instruments to grasp or dislodge the plate, but they all proved abortive; and it was found impossible to pass any instrument between the foreign body and the walls of the gullet, so as to get it below the obstruction. I, however, at length, succeeded in introducing a flexible catheter (No. 5), which appears to have found its way between the horns of the clasp which formed one end of the plate. As a means of conveying fluid into the stomach had thus been obtained, it

was suggested that the action of vomiting might possibly alter the position of the plate, and render it more accessible from the mouth. A pint of milk was accordingly conveyed into his stomach, and then half a drachm of sulphate of zinc, and a scruple of powdered ipecacuanha administered. Strange to say, not even a sensation of nausea was produced, and the emetics were retained without exciting the slightest constitutional effects. A mode of administering nourishment had however been obtained and we could better afford to wait and take the chance of any favorable contingency. On Saturday, January 19th, I made another attempt to move the plate. Since the previous day I had twice fed the patient with milk, wine, and beef-tea; but the catheter was passed with great difficulty, and there was only one particular spot on the left side where it could be made to penetrate into the œsophagus. He was unable to swallow a drop of fluid by natural efforts, but derived great comfort from sucking ice. I attempted to pass a looped wire round the plate, and also manipulated with a flexible tube from the extremity of which a pair of forceps could be projected, but no success was obtained, and farther proceedings were for the present laid aside. On Sunday, January 20th, no attempts were made, but I fed the patient three times through the catheter, the introduction of the instrument becoming more and more difficult each time. On Monday, January 21st, I again met my colleagues in consultation. It was now imperative that some decisive step to remove the foreign body should be undertaken, as the flexible catheter could no longer be passed, and the patient was beginning to feel seriously the want of rest and nourishment. The position of the plate had been pretty clearly ascertained. It was impacted either at the commencement of the œsophagus, or else just above (where the œsophagus and pharynx join). It was determined to cut down and open the gullet. Mr. Hilton assisted me in the operation.

The patient was placed on his back, with his head and shoulders slightly elevated. Chloroform was given, and he was soon quietly under its influence. The incision was made on the left side, and extended about four inches and a half in length, from the upper edge of the thyroid cartilage nearly as far down as the sterno-clavicular joint. The platysma and

cervical fascia were divided, bringing into view the carotid sheath and the omo-hyoideus muscle, which was thick and fleshy where it crossed the wound. This latter was divided to get it out of the way, as were also some filaments of the descendens lingualis nerve, and two or three small arteries which were immediately tied, to prevent as much as possible infiltration of blood into the cellular tissue. A little farther dissection laid bare distinctly the common carotid artery, the inner connexions of which were easily separated with the handle of the knife and the fingers.

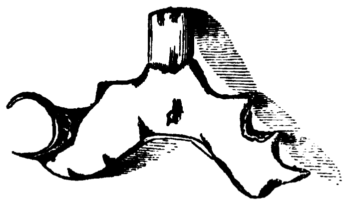
I considered it to be an important object to separate completely the carotid artery from its internal attachments; and this having been accomplished, the vessel together with the sterno-mastoid muscle was drawn outwards and retained by retractors; and thus rescued from injury or molestation while the farther steps of the operation were carried on; the object of which was to reach the upper portion of the œsophagus.

The thyroid body was now exposed by dividing a few of the external fibres of the sterno-hyoid and sterno-thyroid muscles, and the dissection was continued along the outer surface of the gland backwards towards the spine. The tissues were separated partly by the blade, partly by the handle of the knife. An artery, probably a branch of the superior thyroideal, was divided where it crossed the upper part of the wound, bled freely, and was secured with some difficulty. A larger vessel, probably the inferior thyroideal, was seen running across lower down, but escaped without injury. The larynx and trachea were gently drawn over towards the right side, so as to widen the large wound which gaped on the left side of the neck.

The œsophagus was reached by following round the surface of the thyroid body, which completely covered and concealed the trachea.

About two inches of the gullet could now be traced with the finger, but no projection indicating the presence of the foreign body could be felt. It therefore seemed pretty certain that the plate had not descended into the œsophagus, and must be lodged in the lower part of the pharynx. After some difficulty, and by tilting the larynx a little forwards and

over to the right side, the finger was passed behind it, that is, between the pharynx and the vertebræ, and the body was now obscurely felt exactly behind the cricoid cartilage, protected, as it were, by the inferior cornua of the thyroid. The point of the knife was now brought to bear on what seemed to be the most prominent part, which proved to be the single tooth; and the grating sensation of the blade indicated that the pharynx was opened, and the foreign body reached. The white tooth, in fact, became visible at the bottom of the wound, and, being grasped with a pair of forceps, the opening in the pharynx was dilated upwards and downwards with a *blunt*-pointed bistoury. After a little manipulation, one end of the plate was disentangled from its attachments and brought out of the wound, but the entire body was not extricated until a farther slight division of the walls of the larynx had been made. This, however, was soon accomplished with the assistance of Mr. Hilton, who cut along the now exposed edge of the gold plate, while I gently withdrew it with one hand, and protected and held open the side of the wound with the fingers of the other. The patient was carried to bed, and cold water applied to the wound, no means being used to bring the edges together. On recovering from the effects of the chloroform, he seemed to have suffered but little from the operation, expressed himself as comfortable and free from pain, and returned eagerly to his former occupation of sucking ice. An enema of beef-tea and wine was thrown up, as he had had no nourishment since the previous day. In the evening he complained of great exhaustion, amounting to a sense of starvation, and I gave him nourishment through the catheter, and also a full dose of opium.



January 22d.—Was free from all untoward symptoms, and only complained of an empty stomach. He was fed with beef-tea three times through the catheter. Sucking ice was a great luxury; and although he believed that none of it passed into the œsophagus, yet, as far as we could ascertain,

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no water found its way out by the wound. On the third day, January 24th, I introduced the common œsophagus feeding tube, which passed readily without pain or obstruction. He was subsequently regularly fed by his own dresser, Mr. Dyer, at first three times, but afterwards, at his own request, four times in the twenty-four hours. He was always ready, indeed eager, for his meals, and received them with great enjoyment. His diet consisted of beef-tea, brandy and egg, arrowroot, with milk or wine. Notwithstanding this nourishment, of which he swallowed about four pints a day, he gradually but evidently lost flesh and strength. Accordingly, I ordered as much pounded meat to be mixed with the beef-tea as could be made to pass through the œsophagus-tube, and directed an ounce to an ounce and a half of cod-liver oil to be given at each meal. He took an opiate each night, but the quantity was directed to be gradually diminished.

February 5th.—The addition to his nutriment or the oil, or both, have produced a decided improvement in his appearance, and he expresses himself as feeling stronger and better. His spirits have all along been good and hopeful.

The wound has looked healthy from the first, and is now contracted to half its original size. Since the operation nothing has been swallowed by natural deglutition, and he is very unwilling to make the attempt, as it causes considerable pain and a sensation as if the wound was being rent open. He does not appear to swallow his saliva.

His improvement was now progressive and rapid. In three weeks after the operation the use of the feeding tube was abandoned, as he was enabled to swallow with daily increasing facility. In about another week the external wound had closed, and the recovery might be said to be complete. The operation, however, appeared to have produced a very decided alteration in his voice, which had previously been clear and strong; and when he shortly afterwards left the hospital, in good health and spirits, he still continued to speak with a sort of hoarse husky whisper. Indeed there was an almost entire loss of those tones which appear to depend on the tension of the vocal chords, and as there was no reason to suppose that the mechanism of the larynx had suffered from the temporary lodgment of the foreign body, it seems fair to

infer that the filaments of the recurrent laryngeal nerve which supply the arytænoid muscles had been partially or wholly divided in the operation. The situation and course of these filaments, corresponding with the track of the knife when the pharynx was opened, renders this supposition highly probable.

I had the pleasure of seeing Mr. Guilford a few weeks ago. He has been married about a year, is well and hearty, has acquired stoutness, and, as he affirms, stature, since he was my patient. His voice has regained a strong and manly tone, but has undergone a decided transformation. In his earlier days he somewhat prided himself as the possessor of a fine tenor voice, he now owns a very respectable bass. How much of this change is owing to natural transition, and how much to the division of the recurrent laryngeal filaments, may be a matter of speculation. It is, however, almost impossible to cut into the lower part of the pharynx without compromising more or less the nerves which supply the arytænoid muscles.

I have purposely interwoven many of the practical points connected with the operation of opening the gullet into the foregoing portion of this paper, so that the moral of the story may be comprised in a very few observations.

Much valuable instruction may be gained from the monographs of Arnott and Begin, whose decisive views and opinions on the subject, founded on practical experience, may well supersede the more timid and vacillating policy advocated in many books of surgery. Œsophagotomy has been too rarely performed to allow us to speak with absolute certainty, as to the dangers which may be incident to it as an operation, or its positive success as a remedial measure. There can, however, be no doubt that the fatal result in the two cases out of the seven recorded, depended, not on the operation, but in the one on the delay and the presence of severe pulmonary mischief, and in the other on the unmerciful palliative treatment which preceded the use of the knife. It is somewhat singular, that in all the successful cases the precise locality of the foreign body was neither marked by any external prominence, nor indicated by any accurate reference of pain to one particular spot. Indeed we can hardly expect that either of these conditions should ever occur, although their presence has

been strongly insisted upon as necessary guides in the performance of the operation, and indeed as a *sine qua non* as to the propriety of undertaking it.

However slender our experience may be, the feasibility of the operation is established by the facts, that it is quite possible to make a long deep incision along the side of the neck, and to continue the dissection down to the bodies of the vertebræ without compromising any vitally important organ or tissue. That the incision recommended, practically separates the sterno-mastoid muscle and the carotid sheath with its dependencies on the one hand; from the larynx and pharynx the trachea and œsophagus with the thyroid body and its superjacent muscles on the other. That the only structures which necessarily cross this incision in its length and depth, are the omo-hyoideus muscle, the muscular filaments of the descendens lingualis nerve, and the superior and inferior thyroideal arteries, both of which last may probably elude the knife or be promptly secured if wounded. That a considerable longitudinal incision can be made into the gullet, whether pharynx or œsophagus, without present mischief or future detriment. That experience shows how much more likely the gullet is to suffer from the retention of the foreign body or the means used for its extraction, than from the knife of the surgeon.

The two great practical points in the operation are—1st, the isolation of the carotid sheath to the outer side, leaving the surgeon to make his approaches towards the gullet in comparative security; 2d, the immediate arrest of hæmorrhage by tying every vessel, whether artery or vein, which bleeds, thus avoiding the obscuration produced by infiltration of blood into the cellular tissue.

I am inclined to believe that a foreign body might be extracted from any portion of the cervical gullet; including a range, commencing above from that point of the pharynx which may be inaccessible from the mouth, and terminating below at the upper opening of the chest. It might even be possible to extract a foreign body from the early thoracic portion of the œsophagus; provided it could be reached with the finger, and thus brought under the influence of a pair of curved forceps.

The most accessible part of the gullet is, doubtless, the two first inches of the œsophagus, included between the upper and lower thyroidal arteries. The two sides of the incision may here be most readily separated from each other, allowing a wide gaping wound for the inspection and manipulation of the surgeon. The recurrent nerve would also, as a single trunk, be less obnoxious to injury than the set of filaments into which it divides higher up.

Below this point, or as we approach the upper opening of the chest, the difficulties of the operation would progressively increase, in consequence of the closer proximity of the carotid sheath to the trachea and œsophagus, and the consequent narrowing of the wound, whose sides are, as it were, formed respectively by these structures.

Lastly, the exposure and incision of the lower part of the pharynx is attended with its own peculiar difficulties, which have already been mentioned in the description of the operation which I performed. Had the gold tooth-plate been lodged in the upper part of Mr. Guilford's œsophagus, its extraction would probably have been more easily accomplished: but the protection and concealment which was afforded to it by the cricoid cartilage in front, and the posterior edge and inferior cornu of the thyroid cartilage, which overlapped it at the side, rendered the access to the foreign body difficult and tedious, and materially complicated the operation.

It may be considered a matter of small importance on which side of the neck the operation for œsophagotomy is made, and, except in three instances, it is not alluded to in the records of the few operations which have been performed. Mr. Arnott incised the neck on the right side, and no doubt had a good reason for his choice. Now, unless the ascertained situation of the foreign body or any other circumstance indicated otherwise, I should undoubtedly prefer to make the incision on the left side of the neck. The patient and the surgeon are, I consider, thus placed in a more favorable relative position. A freer use of the right hand is obtained, while the left hand may be most advantageously brought to bear upon the larynx, trachea, and thyroid body, forming the inner side of the wound and covering the gullet towards which the

surgeon has to make his way with the knife. As regards the carotid sheath and sterno-mastoid muscle, forming the outer wall of the incision, the operator must depend on his able assistant to hold them back and keep them out of harm's way. In making these observations, I am supposing that the surgeon is standiug on the left side of his patient.

CONTRIBUTIONS TO THE PRACTICAL SURGERY

OF

NEW GROWTHS OR TUMOURS.

SERIES II.—FIBRO-PLASTIC GROWTHS.

By JOHN BIRKETT.

In the last volume of 'Guy's Hospital Reports,' I related several cases of cancer, to illustrate the progress and result of that disease. This communication will be devoted to cases of "fibro-plastic growths."

Dr. Lebert was the first author who employed this term which has been generally adopted by writers on pathological anatomy, since the publication of his work.[1] These tumours are generally globular, forming growths of a more or less spherical or ovoid shape, the surface of which is irregular, either superficially or deeply lobulated. They generally have a delicate, vascular envelope of fibre-tissue adherent to their surface, and which completely invests them.

Dr. Lebert describes two kinds of fibro-plastic tumours, between which a marked distinction exists, not only in their external characteristics, but in their minute elementary structures.

The first kind consists of soft and lobulated growths which from being sometimes as soft as medullary cancer has been

[1] 'Physiologie pathologique,' &c., by H. Lebert, M.D., 2 vols. 8vo, and plates. Paris, 1845.

confounded with it. But in the fibro-plastic growths the fluid which can be pressed from them is transparent, clear, and of a pale, delicate yellow, whilst in cancer the fluid is opaque and lactescent. The tissue of the fibro-plastic tumour, although soft, always offers a certain amount of resistance to pressure, and is with difficulty compressed between two pieces of glass. Cancer, on the other hand, is generally destroyed by very gentle compression, unless it be of the hard, fibrous, infiltrating kind, with which these growths could not be confused. The lobes and lobules composing the mass vary in size in every case. They have generally a yellowish tint, unless vascular, or containing effused blood, in which case they are of a paler or darker blood-colour. In many cases a remarkable resemblance exists between these growths and the polypus growths from the nasal mucous membrane.

The second kind of fibro-plastic tumour is much more firm and resisting, it cuts like a somewhat leathery body, is homogeneous throughout, but never attains the dense, close texture of the purely fibrous growths. The interior of the growth varies in colour from pale yellow to red, more or less bright or dark in proportion to the amount of contained blood, either in vessels or extravasated. The surface of a section slowly changes colour from nearly white or pale yellow to a rose or pink tint, as the blood corpuscles are acted upon by the atmosphere.

The growth of these tumours is generally slow, especially of the primary development, but if after extirpation of this growth, the disease should recur, the secondary and even subsequent tumours are developed generally at a more rapid rate.

Morbid changes take place in the fibro-plastic growths as in other parts, induced by inflammatory action and large portions may even slough, and the skin over them ulcerate. Of this action a good example will be detailed in Cases IV and X.

All the organs of the body, especially those parts in which the fibre-tissues abound, except the viscera of the thorax and abdomen, may become the seat of these developments. By the pressure exerted by the new growth upon neighbouring organs their tissues may be absorbed, and thus the more resisting, as the bones, are occasionally destroyed, and their remains seem to constitute integral portions of the growth. This

effect is well demonstrated in the instance of the destruction of the upper part of the fibula in Case VIII.

In the majority of the cases which have fallen under my observation, the growths have been developed underneath or in relation with the fascial envelope of some portion of a member. This, however, is not always their position, for sometimes they are developed in relation with the cutis, and growing outwards, they form pedunculated and pendulous wens, with very narrow stalks.

When these growths are recurrent they seem especially to select the immediate neighbourhood of the primary development—a feature in their natural history well demonstrated in some of the cases which follow. And they also appear to have a great tendency to extend deeper and deeper among the tissues and organs of a limb. In this circumstance of local recurrence they resemble carcinoma, but they differ widely from that terrible scourge, in the fact, that the internal organs of the thorax and abdomen are not invaded by growths of fibro-plastic tissue. A case will be related, in which fibro-plastic subcutaneous tumours existed in a woman diffused over her body, and when she died two or three small tubercles of carcinoma were seen in the lungs, but there were no fibro-plastic growths accompanying them.

Of patients, therefore, from whom fibro-plastic growths are removed, a more favorable prognosis of their case may be given than of those in whom we meet with carcinoma. In my last communication on that new-growth, it was shown, that in persons the subject of carcinoma, at some period, sooner or later, the thoracic or adominal viscera, or some organ distant from the seat of the primary development, became invaded with the same disease. On the contrary, I shall here demonstrate that, although the primary growth being removed, another may reappear over and over again, yet that the development is confined, in most cases, to the immediate site of its first appearance, or to some part of the member to which it grew.

Another characteristic feature of the fibro-plastic growths, and a very marked one, is this, that in all stages of their growth, whether before or after ulceration of the integuments, the lymphatic system is not involved in the disease. In not

one case shall we find that the lymphatic glands of an organ in which these tumours were growing had ever become infiltrated on the seat of a similar disease.

One of the cases illustrates the fact, that with the fibro-plastic growths cancer may be developed at a subsequent period, but this is the only instance in which the occurrence of the two diseases in the same individual has fallen under my observation. Case XIV.

After the perusal of the following cases, the practical surgeon will admit that we are justified in removing growths of this nature whenever they appear, and, in doing this, I believe it is a point of great importance to remove the surrounding parts as freely as possible.

I have arranged the cases into two classes—the first contains those of the soft, succulent, gelatinous, translucent, and rapidly growing varieties—the second the more firm, fibrous, sometimes almost juiceless, and more slowly growing.

The first case is an example, on a small scale, of one of these growths superficial to the fascia lata, which, after having been observed several years as a small lump beneath the integument, rapidly enlarged, and soon ulcerated through the skin. It was remarkably cystiform in its anatomical relations, and the contents of the cysts were very soft and gelatinous. The attachment of this growth to the fascia lata was very firm, and a small piece was removed with it. This, although an exceedingly small growth, is typical of the class which, as will be demonstrated, attain in some instances most enormous proportions.

Case I.—*Fibro-plastic growth on the thigh; excision, cure.* (Drawing 197^{51}; prep. 1369^{25}.)

J. H—, æt. 52, a merchant's clerk, had observed for several years a pisiform nodule beneath the skin of the outer femoral region, about three inches below the trochanter major. He was admitted under my care in October, 1853. Three months before this the growth above described enlarged, and two months since the skin over it ulcerated, and there had been more or less hæmorrhage from it since then. He was a healthy, well-nourished man, and had lived temperately. I excised the

growth which was attached to the fascia lata very freely. The wound healed slowly, and when I saw this patient a year afterwards the cicatrix was healthy.

A section showed the growth which was about one inch and a half in diameter to be composed of a collection of circumscribed lobules of a more or less spherical shape. Each lobule was composed of a soft, succulent, yellowish, translucent substance, resembling thick size, and this substance was surrounded by a delicate membrane. One lobule had ulcerated through the skin and from this the blood came. The whole mass was not very vascular. A clear, transparent, tenacious fluid could be pressed out of it. The minute elementary tissues were oval, nucleated cells, fusiform cells, and a very delicate fibre-tissue.

The second case is an example of a series of new growths very often developed in the region of the parotid gland, or some other part of the neck; regions in which there is a large quantity of connective tissue and fascia. Very often we meet with cartilage-tissue in a very granulated form dispersed through these growths, and occasionally tumours which are almost wholly composed of cartilage. In the instance here given the development of the growth to the size described occupied many years. It was unattended by pain, and its size and disfigurement were the chief sources of trouble. The diagnostication of these tumours is not very difficult. The lobulated surface and healthy appearance of the integuments, the elasticity to pressure, the hardness in some parts, the slow growth, the healthy aspect of the patient, the painless character of the mass, both in itself and in the surrounding parts, and its mobility, are all circumstances which would lead the practical surgeon to prognosticate its nature. By means of the trocar and canula a puncture may be made into the mass, and a small portion removed for examination. When this is done there is not the same amount of bleeding from the puncture as when the disease is carcinoma. I have seen a case in which a growth of this kind, and in this region, was recurrent. It occurred in a woman who, during a period of between thirty and forty years, had had three tumours excised, the intervals between their recurrence being very long.

CASE II.—*Fibro-plastic growth in the cervico-facial region; removal; cure.* (Drawing 197^{79}; Prep. 1361^{48}.)

A woman, æt. 41 years, came from the country into Guy's Hospital, in November, 1856, having a large tumour at the right side of her neck. A small lump was first observed fourteen years before, and in that period it had grown to the dimensions represented in the lithograph by Mr. Hurst, Plate I. The growth was lobulated, some of the lobes being softer than the others. The integument, although thin, was scarcely altered in colour; it was painless, not very heavy, and it was very moveable, and did not seem to be very deeply attached.

On November 25th, I excised the tumour, which had a well-defined but delicate envelope, and it rested on the tissues occupying the fossa, between the ascending ramus of the lower jaw and sterno-mastoid muscle. The parotid gland was not involved in the growth, but somewhat spread out on its anterior border. There was hæmorrhage from one large artery only.

Dr. Wilks examined the growth, and the particulars with which he favoured me I confirmed by my personal observation. When cut, the tumour had a yellowish colour and translucent appearance, and resembled a mass of gelatine. It was, however, firmer and drier than jelly but less tenacious, being easily broken or torn; the severed parts being irregular and not at all fibrous. Not a trace of structure could be detected by the unassisted eye, and thus the tissue of the growth had the appearance of a homogeneous mass of gelatinous or lardaceous substance. When squeezed, it emitted only a little watery serum. The microscope revealed, however, fibres, but these were so delicate that it required a very good defining power to discern them. They interlaced in all directions, but sprang in the first place from distinct centres, and then branched out like the stem of a tree. Amongst the fibres, oval nuclei were seen which, in some places, were aggregated in clusters amongst the fibre-meshes. No appearance of cartilage was discernible.

The wound healed rapidly; and twelve months afterwards I saw her quite free from any disease.

In the third case the tumour was developed at a somewhat early age and grew very much more rapidly than in most of the other cases. The locality of its development was a region in which the anatomical disposition of the expanded fibre-tissue is, perhaps, as strongly marked as in any other part of the body. The new growth was in intimate relation with the fascia of the leg, as well as with the fascial aponeurosis of the inner ham-string muscles. The disease in this case commenced by the patient feeling pain at a spot, and after this the tumour was noticed. This is not a common history of these growths. In the majority of cases the tumour is first felt, and no pain attends the development, until either bones become diseased, or nerves are pressed upon or involved in the growth.

A characteristic of this case was the rapidity of its development throughout; for, after the second operation, an increase in the size of the growth became apparent day by day, and this circumstance, together with the fact that the disease extended so deeply into the popliteal space, that it was impossible to enucleate it, induced me to perform amputation. The girl was constitutionally extremely delicate and very much out of health, and probably to these circumstances the rapidity of the growth may be ascribed.

CASE III.—*Fibro-plastic growth about the head of the tibia; removal; recurrence; removal; recurrence; amputation through the femur; cure.* (Drawing 37^{12}, and Preparation 1376^{30}.)

In September, 1855, a girl came under my care in the hospital on account of a swelling over the inside of the head of the right tibia. Six months before, when nineteen years old, she felt pain just below and inside the knee, as if she had bruised the part. She came from Rotherhithe; had pursued the occupation of a domestic servant, had never enjoyed robust health, and was of a well-marked strumous diathesis. The catamenia were irregular and she showed signs of very defective nutrition. When admitted, there was a rather soft, elastic, almost fluctuating tumour, of globular shape, and about four inches diameter, over the inner side of the head of the tibia. It was occasionally the seat of pain, but never very

severe. Its size had not changed during the last month. The integuments were very thin over the growth without, however, being in any way involved in the disease. In September, 1855, I excised the growth, together with a portion of skin. It was very soft, almost like jelly, enclosed in a delicate envelope and was not very vascular. It seemed to grow more especially in relation with the fascia, the expanded tendons of the inner ham-string muscles and to dip backwards into the popliteal space to the gastrocnemius tendon. The growth was succulent, but the juice clear and transparent, of a pale yellow tint. The elementary tissues were nucleated fusiform corpuscles, delicate fibres, and a few oval nucleated cells.

The wound sloughed superficially, but healed slowly in a week or two.

In November, two months after the operation, a growth again appeared which increased rapidly; and in December, I removed it. This exhibited the same structure as the first. The wound sloughed; and as cicatrization advanced, a new growth sprung up and extended so deeply among the muscles and vessels of the popliteal region that I was compelled to amputate through the femur. This operation was performed at the junction of the middle with the lower third of the bone. The stump healed slowly and she left the hospital in May, 1856, quite well.

The last time I saw this patient was at the end of 1857, or about one year and a half after the amputation, and she was quite well.

Few cases have caused a more lively interest in the hospital than the one to be next related. The youth of the patient, the sufferings to which she was necessarily subjected at so early an age, and the fortitude and determination with which she bore up against her afflictions, excited a large amount of sympathy from all who witnessed her trials.

The progress of the disease occupied a period of nine years and a half, and during this time she was subjected to not less than seventeen operations. These consisted of excisions and the destruction of the growths by the applications of caustics. In spite, however, of every local application, and even after

excision of the growth with much freedom and with excessive care, that none then existing should remain behind, the disease recurred. Nothing in the way of operation, short of amputation, seemed at last to offer any chance of freedom from the disease; and had this severe measure been adopted, we might argue from the revelations of the necropsy, in favour of the proceeding. Not a trace of the existence of any new-growth was developed in the viscera; and therefore, assuming that the disposition to the formation of the fibro-plastic structure was purely local, a hope might have been entertained that the girl would have been thus freed from the complaint.

The origin in and relation to the fascia lata are displayed in a very marked way by this case, as well as the greater rapidity of the growths which are developed subsequently to the removal of the primary formation.

Case iv.—*Fibro-plastic growth in the thigh; repeated developments and removal of the growths during a period of ten years; death from phlebitis.* (Drawing 176^{56}, 199^{45}.)

This patient, a girl, æt. 16, was admitted by Mr. Cock, in August, 1847. She stated that she observed a small swelling in the anterior region of the right thigh, when fifteen years old. It was quite beneath the skin, soft, moveable, and very painful. Her general health, she said, was delicate, but her appearance was that of very good health. In the locality of the growth she received a contusion, when between thirteen and fourteen years of age. On admission, there was a small tumour which had been slowly increasing twelve months in the skin of the anterior femoral region, at about the junction of the superior with the middle third. It was excised by Mr. Cock in December, 1847. Its structure was soft, succulent, and vascular. The minute elements, delicate fibres of fusiform nucleated cells. The wound healed favorably, in about one month.

Three months after this, in May, 1848, she noticed another lump by the side of the cicatrix which increased slowly, and in October of this year a second growth was removed. This had an appearance like the last except that here and there were small cysts, filled with soft jelly-like material. The

minute elements were identical with the first. The wound healed in November and she left the hospital well.

In April, 1849, another growth appeared by the side of the cicatrix. It was very painful and the pain was of a sharp darting character. The cicatrix appeared quite healthy and was not at all involved in the growth which was quite moveable beneath the skin and felt as if composed of small lobes. This tumour was removed by Mr. Cock, in October, 1849. It was dissected out with great care with the whole of the cicatrix and a portion of healthy skin around both. One artery bled freely; and a nerve, one of the anterior crural cutaneous filaments which ran into the cicatrix, was divided. The nerve, upon subsequent dissection, was traced into the new-growth, divided therein, and had a ganglionic enlargement on one of its branches in the cicatrix. Hence an explanation of the great pain she suffered. This growth was lobulated, firm, did not break up on pressure, and contained a little albuminous fluid. The section was uniform, smooth, and of the same appearance throughout. It was about an inch and a half long, and one inch broad, and of rather a greater thickness than the panniculus adiposus in which it was developed. The very small lobuli had a somewhat vesicular appearance, and in its general aspect it resembled a polypus nasi. The cutis was not implicated, that is, infiltrated, it was simply adherent to the new-growth. Its lobes extended intimately with the lobes of fat. The minute anatomy consisted of a very delicate fibre-tissue, with fusiform, nucleated bodies and oval corpuscles in abundance, but none of the elements found in carcinoma could be detected. The wound healed well and she continued free from any local disease about six months.

In November, 1850, she was again admitted by Mr. Cock. The local disease had reappeared and had been growing about six months. She now looked very ill, she was thin, had no appetite, and, from her facial aspect, the existence of some constitutional dyscrasia might have been prognosticated. The local growth was much larger than it had been before, it had ulcerated through the integuments, and an elongated, polypoid growth projected through a circular opening in the skin. The growth was not adherent to the edges of the ulcer, but hung out very like the intra-cystic growths seen in some cases of

adenocele. There was not any disease of the lymphatic system. On this occasion Mr. Cock removed the mass, together with the subjacent fascia lata, to which the growth was adherent, on November 30th. This growth consisted of lobes, one of which was sloughing. It had penetrated the fascia lata in one point, and here and there showed small, red, vesicular bodies, like the preceding. The elementary tissues were the same as in the other growths. Mr. Hurst made a drawing of the disease, in which the appearances above described are represented (No. 199^{45}). The wound was some time healing, and the patient was free from any local disease about fifteen months. During this time she grew strong, had the appearance of enjoying good health, and her nutrition was in no way defective.

At the commencement of March, 1852, a new-growth appeared at the edge of the cicatrix, for the fifth time, and it was excised on the 19th, having been observed fourteen days. This one was about an inch and a half in its longest diameter, it grew beneath the fascia, below the cicatrix, was lobulated, succulent, and of a brilliant red blood colour. Its elements were chiefly a most delicate fibre, with fusiform cells. The wound healed slowly, although small.

At Christmas, 1852, she gave birth to a child, having been married about thirteen months. She suffered much at the time, and suckled for five weeks.

In March, 1853, she observed the sixth growth, over the last cicatrix, which increased rapidly, and ulcerated through the skin at the beginning of June. She entered the hospital July 6th. There was a sloughing mass, five or six inches diameter, projecting through the femoral integuments, and hanging so loosely from the superficial muscles of the thigh, that it appeared as if it would have dropped off. The woman's health was good, and the inguinal lymphatic glands unaffected. This growth was removed July 12th. It was slightly adherent to the muscles of the femoral region, and a small portion of one of them was removed with it. The surface only of the growth was sloughing. A section exhibited a peculiar tint, in consequence of striæ extending from the fascia to its surface, of a pearly and bright red hue. Here and there were small cavities filled with extravasated blood. The delicate fibre-element, described before, prevailed in this growth likewise.

From the cicatrization of the wound produced by this operation until June, 1856, she was under the treatment of Mr. Cock, in the hospital, and of others outside its walls. Excision of new-growths identical in structure with those already described was performed by Mr. Cock, in April, 1854, and in September, 1855. At the last operation the disease extended very deeply, and a portion of the sheath of the femoral vessels was removed with it. Growths which appeared in the interval between these dates were destroyed by caustics.

In June, 1856, the woman entered St. Bartholomew's Hospital, when another growth was removed, and eighteen days after this operation she died, under the influence of phlebitis.

Mr. Paget sent me the following particulars: "The tumour that I removed from C. S— was a large, soft mass, protruding from the middle of the scar or scars of seventeen operations performed for the extirpation of similar tumours. Portions of the tumour were imbedded in the rectus femoris and vastus internus, and it was necessary to remove part of the sheath of the femoral vessels. At the autopsy, the effects of peritonitis were found (probably of pyæmic origin), but no appearance of morbid growths of any kind in any internal organ."

For the next case I am indebted to Dr. and Mr. Bossey, of Woolwich, the last-named gentleman having operated on it on several occasions. It is introduced here because in many points it resembles the last described. Drawings of a portion of the new-growth in each case resemble one another so closely, and the repeated local recurrence of the disease in the two cases is such a prominent feature, that I believe them to be identical.

This case extends over a period of about eight years, and during that time growths were excised upon seven occasions, at irregular intervals between each operation. Their relation with fasciæ and aponeuroses was strongly marked; for where, in the whole body, are these tissues so fully developed as about the scapula and its muscles and those of the dorsal region? The tumours in this case reached to dimensions far exceeding those in the last, and there was a disposition to the extension of the disease, by spreading from its primary site to another part of the scapula. I regret very much that the post-mortem

condition of the liver was not ascertained, and it must remain a matter of doubt whether there was or was not some new growth developed therein.

CASE V.—*Fibro-plastic growth about scapula: seven operations for its removal; death from gangrene.* (Drawing 37[3], Prep. 1362[48, 64, 65].)

Of this case, which occurred several years since, and from which there are three preparations and a drawing in the museum, Mr. Bossey, of Woolwich, kindly sent the particulars to me.

1. A convict, W. D—, aged 46 years, observed, in the year 1826, a growth in the region of the anterior border of the scapula. He stated that at first it grew slowly, but subsequently with great rapidity. This was removed at the Newcastle Infirmary, in 1827, its dimensions being about the size of a pint basin. He was free from the disease for a few months.

2. It again appeared, and was removed in the same institution, nine months after the first operation.

3. In 1829 he came under the care of Mr. Bossey. At that time there was a growth in the site of the former tumours, not painful when roughly handled, the skin over it slightly redder than the surrounding parts, apparently from venous congestion, as there were tortuous veins meandering over the surface. It was attached to the skin, but appeared moveable from the surfaces below. To the touch it was elastic and lobulated, and, being more firm at some points than at others, it had not the doughiness of an adipose tumour, and yet it was evidently sarcomatous. Mr. Bossey removed the growth in August. It consisted of an assemblage of cysts, adherent to each other and to the surrounding textures, of various sizes, from that of a hazel-nut to a large hen's egg, and each cyst contained a mass of irregular shape, according to the pressure to which it had been subjected in its growth, and of a uniform density and texture. The colour of these masses was of a dusky red, the larger ones being paler in the centre. Their firmness was about equal to that of the crassamentum of the blood, readily divided by the knife, and as readily parting in

divided surfaces under pressure of the finger or any blunt instrument, yet of tenacity sufficient to be suspended by a thread passed through their substance. The masses extended deeper than was anticipated, passing around and beneath the margin of the latissimus dorsi muscle, and reached the axilla. The axillary glands which were exposed were healthy. All of the growth that could be detected was removed, and the fascia covering the infra spinatus and latissimus dorsi muscle was completely exposed to view. No hæmorrhage of consequence occurred. The tumour, notwithstanding its great vascularity, was nourished by a number of small arteries ramifying in the cysts, and it was only at the points where the arterial connexion existed that there appeared any intimate adhesion between the cysts and the tumours. The wound healed favorably.

4. In the middle of September, another growth appeared just above the line of the last incision, and in three weeks formed a circumscribed prominent mass, three inches in diameter. This was removed by a careful dissection, and the whole cyst, together with the fascia covering the infra spinatus muscle, as well. The structure of the growth was identical with the last. The wound healed quickly.

5. February, 1830. The tumour having again appeared, was, at the above date, of considerable size and in a somewhat different situation to the last. It occupied and overlapped the anterior costa of the scapula, was more fixed, and could be felt in the lower part of the axilla, behind the margin of the latissimus dorsi muscle. In March this growth was removed. It passed through and was embraced by the fibres of the latissimus dorsi muscle, and was connected with the periosteum of the scapula on its inner surface, being there contiguous to the serratus magnus. Its structure resembled the others. Whilst the wound was healing, he had a severe attack of dysentery, of which he was cured by the 3d of May. In June he suffered from dyspepsia, with great fulness and tension in the region of the liver, and some soreness on pressure; the pulse was feeble, respiration much accelerated. After taking Pil. Hydrarg., and being carefully dieted, he was convalescent at the end of July, although some fulness remained about the epigastrium.

6. In August, 1830, the tumour had again appeared in the primary situation, and, besides this, there was a growth on the

back between the dorsal spinous processes, and the posterior costa of the scapula. This dorsal growth was excised in October. It was about five inches long and two broad, and was partly above and partly beneath the serratus posticus superior muscle, extending deeply between the transverse processes of the vertebræ and the tubercles of the ribs. This wound healed rapidly, but the growth from the scapula increased rapidly and acquired considerable magnitude.

7. Under these circumstances, he was admitted into Guy's Hospital, December 24th, 1831, under the care of Mr. Key. By the advice of Sir Astley Cooper, the tumour was removed from the scapula, and the actual cautery applied over the exposed surface of the bone. Erysipelatous inflammation and gangrene attacked the wound, and the patient died from exhaustion, January 18th, 1832, eight days after the operation. The new-growth removed at this last operation was identical with the others.

There are three preparations of the growths removed by Mr. Bossey preserved in the museum, and a drawing made from one of them by Canton. Unfortunately, no post-mortem examination was made; and after making inquiries of gentlemen who remember the case, we are compelled by their statements to leave the subject in an unsettled state.

Dr. Hodgkin has referred to this case in his lectures,[1] but in reply to my inquiries, he writes: "It is Dr. H's impression that the affection was purely local, but he does not recollect whether this idea is the result of his own or Mr. Bossey's examination."

Mr. Bossey, on the contrary, states that he regarded the liver to be in a morbid condition, and on that account demurred as to the propriety of performing another operation.

The next case occupied a period of between six and seven years from the first observation of the tumour. The primary growth increased very slowly for four or five years, but during the twelve months preceding the first operation it enlarged very rapidly. This growth was enucleated with great facility,

[1] 'Lectures on the Morbid Anatomy of the Serous and Mucous Membranes,' vol. i, p. 339. It is therein described "Notice of a firm, fleshy form of Malignant Disease."

and seemed to be a well-defined, circumscribed mass. The normal tissues surrounding it were quite unaffected, as well as the skin over it. The wound healed favorably; and after the lapse of a very few weeks the disease reappeared under the cicatrix. The second growth was removed, and very soon afterwards a third tumour was developed. It is worthy of remark that, during the development of this one, the patient was pregnant; but this condition did not in any degree check its progress, for it grew much more rapidly during this time than any of the former growths, and attained most enormous proportions before parturition. At the date of the amputation she was very much reduced by the recent childbirth and the discharge from the local growth, which had ulcerated. In this case the lymphatic system was not affected, and there were no facts to induce the supposition that any secondary growths existed in the viscera.

Case vi.—*Fibro-plastic growth in the thigh; removal; recurrence; amputation; death.* (Model 52^{20}; Prep. $1376^{50, 51}$.)

A woman, æt. 39 years, was admitted by Mr. Cock, in June, 1856, on account of a tumour in the thigh. She was a healthy woman, in a good state of nutrition, and the mother of six children. Five or six years before admission, she observed a small lump, about one inch diameter, on the inside of the inferior third of the left thigh. It slowly enlarged at first, but the last fifteen months it grew rapidly, causing pain. It was very moveable, being among the soft parts, and the skin over it was healthy. Mr. Cock enucleated the growth with facility in July, 1856. The new-growth measured six inches in diameter. It was invested by a delicate fibrous envelope, was soft, succulent, semitransparent, and of yellowish tint. The elements of the growth were fibro-plastic. The wound healed, but a tumour again appeared, and, in December, was removed. A third growth formed, increased with extreme rapidity; and, in August, 1857, the tumour reached from the hip to the knee. It was, however, very pendulous, but its greatest circumference measured forty-two inches. In August, 1857, she was again admitted into Guy's, and Mr. Cock amputated the leg above

the knee. This mass weighed several pounds. It was composed of large lobes of soft, succulent, yellowish tissue, loosely attached together by connective tissue. A fibrous texture was observable in some of the lobes. It grew entirely in the soft parts of the limb, the bone being quite healthy. Some of the lobes were sloughing, and a large one had ulcerated through the integuments. The elements of these growths were fibro-plastic.

The patient sank from exhaustion, and there was no post-mortem examination; but the lymphatic system was free from disease, and there was no reason to suppose that any new-growths were developed in the viscera.

Mr. Towne made a model of this growth.

The growth of the secondary development in this case was extraordinarily rapid, for the entire mass had attained its magnitude in the short space of seven months. During this time the woman was pregnant, and she was delivered of a child a few days before the amputation.

The seventh case is an example of a fibro-plastic growth, developed at a very early age, in an otherwise healthy girl. It occupied the anterior femoral region, and was intimately connected with the sheath of the femoral vessels. The girl did not seek surgical relief until seven years after the observation of the growth, at which time the size of the tumour was such as to necessitate a formidable operation for its removal. If she had submitted to the excision of it at an earlier age, there would have been more probability of a successful issue to the case. A post-mortem examination revealed no disease either of the lymphatic system or viscera. In this instance, advantage was taken of an exploration by puncturing the tumour, and removing a small portion for examination; for, had this proceeding shown the disease to be carcinoma, an operation would not, perhaps, have been justifiable.

Case vii.—*Fibro-plastic growth in the anterior femoral region; removal; death; necropsy.* (Drawing 197[75].)

A girl, æt. 20, was admitted into Guy's, in October,

1350, under the care of the late Mr. Bransby Cooper. She was unmarried, had been a domestic servant, had enjoyed good health, and her condition of nutrition was very good. There seemed to be no cause to which to assign the development of the growth. Seven years before, when thirteen years old, she observed a hard, moveable mass in the anterior femoral region. This merely produced enlargement of the part; it was not the seat of pain. Her general health had been unaffected, and she had pursued her avocations without difficulty. When admitted, there was a very large new-growth seated among the muscles of the anterior femoral region. It was within the fascial sheath, and, consequently, not very moveable, although it was ascertained that it was not attached to the femur. The femoral vessels passed behind it, and the integuments were quite healthy. In October, 1850, Mr. Cooper made a long vertical incision over the tumour, and enucleated it from the neighbouring structures, but not without some difficulty and considerable hæmorrhage. She rallied very slowly from the effects of the operation, and at no period, subsequently, was she in a favorable condition for recovery. At last she became hectic, profuse suppuration took place from the wound, and she died about five weeks after the operation.

The tumour was from six to eight inches in diameter. A large portion of the mass, a kind of nucleus, was formed of very firm fibre-tissue, in which earthy matter was deposited. The arrangement of the fibres of this part was radiating and their course rectilinear. Around this nucleus masses of a soft tissue in an early stage of development were arranged, and these, at first sight, resembled medullary carcinoma; but, on closer inspection, this tissue was of firmer consistence, and smoother when cut than that new formation, especially after water had flowed gently over it. The mass was very vascular, but there were not those appearances due to extravasated blood, so commonly met with in carcinoma medullare. It was also of a more yellow tint, not the pearly grey tint of carcinoma. The whole mass was surrounded by a distinctly defined fibrous envelope. The minute elements of these softer tubers were undoubtedly those of the fibro-plastic developments, and they differed very widely from those of carcinoma.

This tissue, instead of falling to pieces, like that morbid growth, formed a coherent structure, and with the addition of dilute acetic acid, a kind of coagulation took place. The isolated elements were elongated and fusiform nucleated cells.

A post-mortem examination of the body was made, but there were no secondary growths developed in any of its tissues or organs.

Before the excision of the tumour, I examined a very minute portion of it which had been removed by making a puncture into it with a trocar and canula. By this observation I ascertained the nature of the growth, and it is a proceeding which may be adopted with advantage in many cases.

The following cases illustrate the second class of fibro-plastic growths; those into the composition of which a much more perfectly developed fibre-tissue enters. To these, the term "recurrent fibrous or fibroid" has been applied. The first case is that of a most cachectic-looking man, who observed the "kernel" which was afterwards developed into a large mass thirteen months before he came under my care. All the circumstances of the case, the constitutional nutrition of the man, the rapid development of the tumour, the external appearances which the integuments exhibited, the pain which it caused, and the tactile indications, would lead to the diagnostication of the disease as cancer. I was led to suspect that it was not this disease, however, from discovering that the tumour was not of uniform texture throughout, for here and there were more solid lobes than composed the general mass; and the unhealthy aspect of the man might be attributed as much or even more to social circumstances than to the effects of disease. Besides, all the functions of his body were performed in a healthy manner, and there was no evidence of visceral or lymphatic disease. Resort was had to amputation, because the whole peroneal region of the limb being involved, the enucleation of the growth was impracticable; and if it had been performed, an useless member would have been the result, as shown by subsequent examination of the limb.

Case viii.—*Fibro-plastic growth among the muscles of the leg; amputation; recovery.* (Model 52^{30}; Prep. 1376^{60}.)

In February, 1858, a man was admitted into my ward, having a large tumour in the upper half of the peroneal region of the right leg. He was aged 35 years, but had the aspect of a much older person. His health previously had been very good. Hard labour in the employment of a carman, bad living, and intemperate habits, had doubtless somewhat impaired his function of nutrition, for he was very thin, although his muscles were in good tone. In January, 1857, about thirteen months before he came under my observation, he accidentally noticed a small moveable "kernel" on the outside of the right leg. He attributed this to "a strain" but it gradually increased as he continued work, and, at last, its progress was rapid, and the pain in the part severe. Seeking hospital relief he was for a few days in another public institution, but left it and came into Guy's. At this time, the circumference of the right leg at the seat of the disease exceeded that of the healthy one by six and a half inches. The entire upper half of the peroneal region was occupied by a mass firm and elastic to the pressure of the finger, regular over the surface, except here and there where harder masses might be felt distinct from the rest of the growth. The superficial veins were more dilated than in a healthy state, and the capillary vessels of the skin were somewhat varicose.

He stated that his general health was very good at the present time; and as there was not any infiltration of the lymphatic system, I explained to him the necessity of submiting to the loss of the limb. To this operation he at once assented, and I performed amputation through the lower third of the femur, in March, 1858.

The new growth was developed in the region of the upper half of the fibula. It had destroyed that portion of the bone with the exception of its head, and had pushed the peroneal and other muscles to either side. It formed a completely individual mass among the muscles. It was slightly lobed, firm, fibrous, succulent, and here and there were cavities filled with

serum. Across these, delicate fibrous bands were stretched, which supported minute blood-vessels. The serum running from the growth was clear, bright yellow, and tenacious, drawing out in threads. The minute elements consisted of fibres, oval, nucleated cells, and fusiform, nucleated corpuscles. The stump healed favorably, and all the ligatures had come away, except that on the femoral artery, when a profuse hæmorrhage took place from this trunk. Mr. Bryant tied the vessel at the junction of the upper and middle third of the thigh, from which time the patient advanced slowly to convalescence, and at the moment of writing this he is quite well.

Mr. Towne made a model of the parts amputated, which demonstrates the characteristics of this form of new-growth remarkably well.

The next case is typical of these firm, fibrous, circumscribed growths, and formed a single mass with merely a disposition to lobulation on its surface. It was about twenty-one months' growth when removed. In this case an exploration was made with a trocar and canula and a minute portion removed. The examination of this, by means of the microscope, showed that the disease was fibro-plastic, and, guided by this fact, I postponed the operation until the health of the man was established. When admitted, he was cachectic, and laboured under bronchitis, but Dr. Wilks could not detect any thoracic disease, otherwise than the products of that affection. He improved in health, and at the time of the operation there seemed every chance of a successful issue to the case. For several days he continued to progress favorably, and then fell a victim to pyæmia.

Compared with the last case, the growth differs in being a single mass, merely developed amongst the muscles of the leg, and in being of slower growth. In the last example, the tumour consisted of several lobes, developed from as many centres, and forming a large central mass which had destroyed the fibula by its pressure upon that bone.

CASE IX.—*Fibro-plastic growth in the posterior region of the leg; amputation. Death from pyæmia; necropsy.* (Drawing 198^{70}; Preparation 1376^{55}.)

A man, æt. 49 years, was admitted under my care into Lazarus Ward, in January, 1857. He showed me a large tumour in the right leg, but the limb was œdematous and the growth ill-defined. He was born in a provincial town, but had lived many years in London, following the occupation of a labourer. He had a remarkably depressed, anxious, care-worn aspect, and his nutrition was very defective. In 1852, he was the subject of dropsy, being anasarcous in the face, head, and legs. When under my care, there was no albumen in his urine. He stated that about March, 1856, ten months before admission, he accidentally observed in the posterior and inferior region of the right leg a hard moveable lump. It was about three inches in diameter when first noticed, and its progressive increase had been slow. At times the limb was painful; sharp shooting pain being felt in the lump. Being when admitted in a very cachectic state, and suffering with bronchitis, I deemed it prudent to defer any operation until his general health was established, and the local disease more defined. He remained in the hospital until June, 1857, and then his general health was improved. The bronchitis was cured, he looked less depressed and he had gained in weight. In September of the same year he was admitted again. The tumour was larger, the skin over it was red, and he was suffering much pain in the limb. His leg was removed September 22d. The new-growth was developed among the muscles of the posterior region of the leg, pushing them to one side but not infiltrating them. It consisted of a circumscribed mass with a somewhat irregular and nodulated surface, and was surrounded by a delicate envelope of fibre-tissue. The section was dense, and of a close fibrous texture, from which no juice exuded. It was not very vascular, and the fresh section was nearly white. It measured five inches by three inches and a half. The minute elements were fibre-tissue, oval, nucleated corpuscles, and spindle-shaped, or fusi-

form, nucleated cells. Whilst in the hospital, on the first occasion, I introduced a trocar and canula, and succeeded in obtaining a particle of the growth which showed the same microscopic elements as those of the tumour before described. (Prep. 1376[55].)

For several days the patient progressed very favorably, but symptoms of pyæmia appeared, and he died on the eleventh day after the operation.

Necropsy.—The right lung was gangrenous at its lower part. There were no growths in any part or organ of the body, and the lymphatic system was quite free from disease.

One of the most interesting cases of the series is the next, whether regarded as illustrative of the whole class of these cases, or in relation to the points of practical interest involved in its history. The development of the disease occupied eight years, from its discovery to the death of the patient. The removal of the small primary local disease of six years' growth, was soon followed by another, which, in four months, had nearly acquired the size of the first. These were single masses. The third growth was developed from several centres, as were all the subsequent growths in the leg. The fourth growth, in about two months, far exceeded the bulk of all those before removed, and consisted of several firm nodulated masses, which, by their pressure on the integument, soon produced ulceration. To have removed these growths which extended deeply among the muscles of the leg, would have rendered the limb useless; and the failure of all the former operations to eradicate the local disease being manifest, I therefore amputated through the femur, hoping that at that distance from the site of the primary development the disease would not reappear. About a month after the operation, however, the disease appeared in the thigh, forming at last two large masses, which in seven months attained an enormous size. The patient died from exhaustion induced by sloughing of the tumour and hæmorrhage; but even in this case there were no visceral complications, nor was the lymphatic system anywhere diseased.

Case x.—*Fibro-plastic growth in the leg; removal of the primary growth; recurrence four times; removal, and, at last, amputation through the femur; new-growth in the stump; death; necropsy.* Plate II. (Drawings from 198^{57} to 198^{61}, Preparations $1376^{45, 46}$.)

E. C— came under my observation for the first time in March, 1853. She consulted me about a small hard tumour in the anterior tibio-fibula region of the right leg.

1. It had been first observed about six years before, when she was thirty-five years old, and its growth had been very slow, for now it did not measure more than two inches in its largest diameter. It was very firmly attached to the fascia, very hard, and it projected slightly, or rather elevated the integuments over it. For several years it enlarged very slowly, but during the last few months its increase had been rapid. Lately it had caused considerable pain. The patient was a healthy-looking woman, she had borne children, had enjoyed good health, and her nutrition was good. She considered that the tumour resulted from a blow received on the region. No hereditary predisposition to the development of new-growths could be traced. The lymphatic system was unaffected. I removed the primary growth on March 1st, 1853. It was not attached to the skin, but was very closely associated with the fascial investment of the leg, indeed, dipped down between the fibres of the muscles. It formed a well-defined new-growth, and consisted of two lobes of unequal size. The surface of the section showed small cells or spaces filled with a slightly tenacious fluid of a yellowish or greenish tint. Its structure was fibrous, the fibres being distinctly visible, not at all vascular, and quite free from every trace of milky juice. Of this I have a drawing. The elementary tissues, demonstrated by the microscope, were elongated, fusiform, nucleated cells, characteristic of some of the forms of fibro-plastic growths, as described by Dr. Lebert. The wound healed favorably, and the patient was very soon able to move about.

2. At the end of July of the same year, a second growth

was developed near the cicatrix, but not in relation with it. In about four months it reached very nearly the size of the first, and in November, I removed it. The wound soon healed, and there was no new growth until March, 1854.

3. At this time, three or four small nodules could be felt close together, but independent of each other; that is, as if they sprung from individual centres. These increased rapidly in a month, and they were removed in April, 1854.

4. Cicatrization of this wound was not perfected when more new growths appeared, which increased very rapidly, destroying the newly formed cicatrix, and forming great masses, which projected from the soft tissues of the leg, were of a brilliant blood-colour, smooth on their surface, and merely covered with a thin ichor, neither offensive nor profuse. The external aspect of these growths was highly characteristic, differing from carcinoma by the absence of the fungating surface, so indicative of that disease, by its firmness and lobed outline, and its freedom from offensive odour. The entire upper third of the leg was occupied by these growths which extended deeply among the muscles of the region and forbad any operation except amputation. In the short period of about six weeks the growths had assumed the appearance depicted in the drawing by Mr. Hurst. (Drawing 198^{57}.)

Amputation through the femur, at the junction of the middle and lower third, was performed in July, 1854, and an examination of the limb removed showed that the disease implicated all the soft tissues, more or less. In the illustration (Pl. II) are delineated the anatomical relations of the new-growth, and the muscles and nerves of the member. Isolated masses of the new-growth are seen between the muscles as well as in their substance, and some are seen encroaching upon the anterior tibial nerve and vessels. All the growths subsequent to the primary tumour were composed of elements identical with it. (Preps. $1376^{45,46}$.)

The stump healed favorably, and it may be here observed, that the health of the patient had not been seriously impaired by the previous operations and the necessary confinement in the hospital. She was indeed a woman of remarkably strong nerve, and it was not until completely worn down by intense sufferings, that she yielded to any feeling of despair. At this

time her bodily health was strong, her condition of nutrition very good, and her moral courage most remarkable.

5. About a month after the amputation, when the stump was nearly healed, she called my attention to a slight induration exactly at the spot over which the pad of the tourniquet had been placed at the time of the amputation. For a few days it caused me no anxiety nor gave her any pain, but at the expiration of a fortnight it was quite clear that a new-growth was in process of development. This increasing, caused intense suffering, and in seven months it had reached an enormous size. The drawings ($198^{59, 60}$) illustrate the state of the limb when it had attained its largest dimensions, the circumference of the diseased member measuring seventeen and a half inches in excess of the other. In February, 1855, the stump seemed to be occupied by two masses of new-growth, a superior and an inferior. The femoral vessels were closely involved, so that excision of the mass was impracticable. So intense were the sufferings of the patient, that at one time I proposed to remove the thigh at the hip-joint, and if I had urged the operation I believe the patient would have assented. I was, however, deterred from the execution of this operation by the feeling that as the disease had so repeatedly recurred, it almost amounted to cruelty to inflict upon her another serious operation. At the end of March, 1855, the inferior mass sloughed, hæmorrhage ensued, and she died, exhausted by loss of blood and intense suffering, on the 31st of this month.

Necropsy.—The examination was made by Dr. Wilks, forty-eight hours after death. No signs of decomposition existed externally. No rigor mortis.

The lungs and heart were free from disease.

The alimentary canal was quite healthy.

The liver was white and contained much fat.

The spleen very soft, and the corpuscles very large.

None of the glands of the lymphatic system in any part of the body were diseased.

The urinary and genital organs were quite healthy.

The body generally was greatly emaciated.

The diseased thigh. The whole of the thigh, from the groin to the stump, formed a large mass, divided into two by a transverse depression. The upper and the larger formed a

large, round, and hard tumour; the lower was soft, and filled with blood which, penetrating the skin, produced a clot protruding on the surface. Thus the traces of the two separate growths which had originally existed still remained. The upper tumour could be easily turned out, the integument being in no way involved, and readily peeling off. Neither the muscles nor the femur were attached to it. The muscles surrounding it, although pale, were not at all affected by the disease, and the bone was healthy. The femoral artery and vein ran through the growth, and were quite perfect. They traversed it at about the junction of the upper two thirds with the lower one third of the tumour. The facility with which it could be enucleated was due, in great measure, to the serum which everywhere surrounded it. Although the tumour was perfectly defined, it was not inclosed in a true cyst, but the hardened and dense morbid tissue formed a tolerably firm, fibrous envelope around it. In shape it was nearly round. A section displayed a somewhat soft substance, but which was at the time tough and tenacious, so that a piece of it could not be squeezed out of its original shape into a pultaceous or diffluent mass, after the manner of medullary cancer. It had a firm and leathery denseness, and contained serous fluid. About half the growth was decaying or dead. All the central part was in shreds, and contained small cavities filled with yellow serum. This necrosed part was of a pinkish yellow colour. The circumference of the tumour was of a pale milk-white colour. Between this large tumour and the end of the stump was a similar morbid growth, of less size and less defined. It was rapidly decaying, and was filled with a large quantity of the fibrine of the blood.

The large tumour weighed eight and a half pounds.

The microscope exhibited a very uniform structure of nucleated fibres and fibro-plastic elements. The only resemblance to the elements of cancer was, that in some of the cells the nuclei were of a very large size.

A drawing made by Mr. Hurst depicts the section of the superior growth which had formed in the stump (Drawing 198^{61}). The femoral artery traversed its centre.

A tabulated arrangement of the principal facts of this very interesting case may be here added.

Number of growth.	Age of growth when removed.	Size of growth, when removed.	Time elapsed between recurrence.
1st growth, removed March, 1853.	6 years.	2 inches diameter.	
2d growth, removed November, 1853.	4 months.	1½ inch diameter.	3 months between 1st and 2d growth.
3d growth, removed April, 1854.	4 weeks.	1 inch diameter the largest, but several existed.	4 months between 2d and 3d growth.
4th growth, amputation, July, 1854.	6 weeks.	6 inches diameter at least.	1 month between 3d and 4th growth.
5th growth, death March, 1855.	7 months.	Enormous.	1 month between 4th and 5th growth, and then in thigh.

The age of the patient was thirty-seven years when the primary growth was observed.

It had been growing six years when it was removed, and was then only two inches in diameter.

The patient survived the discovery of the disease eight years, and the first operation two years.

The circumference of the diseased thigh was seventeen inches and a half larger than that of the other side, and this had formed in only seven months.

Not a trace of a similar growth was found in any other part or organ of the body after death, nor were the glands of the lymphatic system in any region diseased.

Case eleven is introduced to show that tumours of this class may be removed, and that for thirteen years the patient may be free from any fresh growth.

Case xi.—*Fibro-plastic growth in the neck for two years; excision.*

In June, 1844, my friend, Mr. Sampson, of Southampton, sent to me a new-growth which had been removed by Mr.

Aston Key from a patient twenty-six years old. It had been growing about two years in the fossa between the angle of the lower jaw and the mastoid muscle. It was painless, elevated above the surrounding parts, and the skin was healthy over it. The lady was in good health, and excision of the growth was performed through a single incision of the skin. The new growth was enclosed in a fibrous envelope which had fat attached to its outside. It was lobed, firm, and rather translucent in some parts, and in others opaque. The exterior of the mass was rather vascular. Oval-shaped cells, with nuclei, were found in the most translucent parts, which formed the largest portion of the growth, and were held together by a very delicate fibre-tissue. The opaque portions showed numerous elongated, fusiform, nucleated elements, and the fibrous tissue was more dense and firm. I could not demonstrate the existence of cartilage-tissue.

The wound soon healed, and in the present year, 1858, now thirteen years afterwards, Mr. Sampson informed me that the cicatrix is quite healthy, and there is no trace of recurrence.

In the following case the history occupies a period of between twenty-eight to thirty years, and the interval between the removal of the primary growth and the subsequent formation was unusually long. The ages of the new-growths before their excision are also remarkable, as well as their slow development. The appearance exhibited by this wen, when on the body, was most striking, and resembled very closely a mass of cancer which was just about to ulcerate. Tactile examination led to the conclusion that the disease was not of this nature, and the healthy condition of the patient and freedom from all lymphatic complication supported this view.

Case xii.—*Fibro-plastic growth on the back; excision; recovery.*—(Drawing 197^{90}, Preparation 1362^{86}.)

My friend, Mr. Freeman, of Minster, requested me to see a gentleman about sixty years old, upon whose back there was a large wen of which he gave the following history. When he was between twenty and thirty years of age he noticed a

small projecting body, like a wart, on his back, which continued to enlarge until it projected some distance from the skin upon a sort of stalk "like a mushroom." It was cut off when it had been growing ten years. The wound soon healed, and for eight or ten years the cicatrix was healthy, and there was no appearance of any growth. Seven or eight years since, however, a second growth was developed, which slowly enlarged until a year since, when it rapidly increased, became at last red and inconvenient from its size alone, for it had never been painful.

When I saw it, in July, there was a very large new-growth, five inches diameter, of hemispherical shape, and in bold relief, situated between the posterior costa of the right scapula and dorsal spinous processes. Its surface was covered with cuticle, which had here and there pealed off or desquamated, and thus formed dry scabs. The colour of it was a shining red and purple, which was produced by a large number of capillary vessels in a state of congestion. In appearance it closely resembled a mass of cancer about to ulcerate. To the touch it was extremely hard; manipulation produced no pain; and in this way it was easy to ascertain that the growth was entirely confined to the integuments.

The patient being in excellent health, the lymphatic system free from disease, and the desire to be free from the annoyance it caused very great, I advised its excision. This was accordingly done by Mr. Freeman, together with about half an inch of the surrounding skin, and the dorsal fascia to which it was adherent. The section of the growth was nearly juiceless. Curvilinear fibres traversed its surface, and it was very firm and resisting, tearing and leaving a fibrous surface in the way that fibrine tears. The elements of the fibro-plastic growths were observable in it. The patient is quite well.

Of the precise nature of the next case there is some difficulty in arriving at a positive conclusion. The microscope showed the elementary tissues of the tumour to be those always seen in the fibro-plastic growths; but the central cavity existing in it is so rarely met with, that some explanation seems to be required of its formation. Whether the local irritation caused by the pressure of the basket-handle

could excite to the formation of such a growth as this must be merely conjectural. Although, in the thick-walled bursæ, the tissues composing the walls of the cyst exhibit some resemblance to those of the new-growths under observation.

Case xiii.—*Fibro-plastic growth in the fore-arm; excision; cure.* (Drawing 197[80].)

In 1850, a young man, nineteen years old, applied to me on account of a swelling in his left forearm. He enjoyed remarkably good health, and had been in the habit of carrying a heavy basket, the handle of which he slung across the affected member.

He observed a small, globular, hard, and moveable lump in the site of the present swelling six or seven years before. It had been painless, and its size only produced inconvenience.

The long axis of the tumour corresponded with that of the forearm, and measured about five and a half inches; its transverse diameter being about two and a half inches. It projected in relief about an inch. Although but slightly moveable, it could be, as it were, detached from the radius and ulna. At least there were no indications of any union to, or growth from, these bones. The tendons of the flexor-sublimis muscle might be traced to the lower end of the tumour, and the impression was, that the belly of that muscle was spread out in front of it.

The diagnostication of the nature of this tumour became a matter of considerable interest, but was attended with many difficulties. The age, healthy aspect, and robust strength of the patient, precluded the idea of the growth being carcinoma, whilst its mobility and apparent freedom from attachment to the bones of the forearm would scarcely admit of the supposition that it was enchondroma. Having seen, upon a previous occasion, a lipoma developed in the same region, I thought that this growth might be of that nature, but its extreme firmness and unyielding texture was very different from such growths. It felt slightly lobed, however, and this character, therefore, resembled the adipose tumours.

I removed the growth by making a vertical incision through the integuments, and separating the fibres of the flexor sub-

limis muscle which were spread over it. The enucleation from the surrounding tissues was easily effected, and the only bleeding was from a vessel deeply seated behind it. Cicatrization of the wound proceeded favorably, and at the expiration of a month he enjoyed the full use of his hand and forearm.

Before the tumour was cut it appeared to be a lobulated mass, the surface exhibiting irregularities, but the whole feeling very firm and hard. It did not appear to be surrounded by a distinct capsule or cyst-wall. A section is represented in a drawing by Mr. Hurst (197^{80}). In the centre was a cavity, filled with a grumous fluid, and traversed by bands extending from side to side. The walls of this cavity were irregular, and had a slight resemblance in places to the columnæ carneæ of the heart. The solid parietes varied in thickness, were of a yellowish tint, firm, and fibrous. No juice could be expressed from them; after the blood had macerated out they exhibited the slightly undulating, pearly surface indicated in the drawing. They were at any time, however, vascular.

The elements constituting this morbid growth were nucleated fibres, nucleated cells, fibres, and filamentous tissues. The nucleated cells were of an oval figure, united together to form masses, and were the chief elements of the entire mass. Much of the fibre-tissue exhibited a double outline, and the nuclei of all the elements became much more distinct when treated with dilute acetic acid.

This tumour clearly belongs to the fibro-plastic class, but whether arising primarily in the remains of effused blood, or originating in a bursal formation, or in a simple cyst developed in the areolar tissue, the walls of which had continued slowly to increase in thickness, must remain a subject of speculation or conjecture.

The last case affords an illustration of the development of different forms of new-growth in the same person. The fibroplastic growths were observable in all parts of the body, subcutaneously at first, and subsequently among the muscles. One of these growths, subjected to local pressure, certainly ulcerated, and was removed. In this locality a second growth very soon formed, and after its removal the disease again appeared, and assumed all the external characters of cancer.

This condition is what used to be called "an innocent tumour putting on malignant action." Yet these tumours were not composed of the same elements as cancer. The patient at last died, and then I found a few small tubercles of cancer in the lungs, but of so trifling a nature, as to give rise to no morbid state of themselves.

The disease extended over a period of eleven years, and the gluteal tumour was ten years before it ulcerated. This was the only one which caused the least inconvenience.

CASE XIV.—*Fibro-plastic growths subcutaneously placed in all parts of the body; ulceration of one of them; removal; recurrence; death; necropsy.*—(Drawings 198[56], 262[85]; Prep. 1369[55]).

A female, calling herself fifty years old, but apparently sixty at least, was admitted by Mr. Cock, in February, 1852, with a large tumour in the external gluteal region which had been growing rapidly the last six months. For the last ten years she had had small tumours seated subcutaneously in every part of her body. They had never given her any inconvenience and, with the exception of that one in the gluteal region, the skin over them was unaffected. Over this one, however, the skin was adherent, red, and elevated, about two inches above the surrounding parts, to the extent of three inches in diameter. This gave her great pain, which none of the others did, and she was desirous to have it removed. Excision of the growth was performed by Mr. Cock on February 10th, 1852. The whole of the new-growth was carefully removed, leaving a perfectly healthy surface of muscle and fascia. A section of the tumour exhibited a succulent, firm, and slightly yellow mass, streaked with blood, and without any milky juice. It contained a considerable quantity of bright yellow tenacious fluid. The tissue was firm and resisting in the centre of the growth, but there was a kind of cortical or outside case which was more opaquely white than the rest. The elements of the new growth were decidedly those of the fibro-plastic tumours, being fusiform, nucleated cells, with a delicate fibre-tissue. Cicatrization of the wound proceeded favorably, and was perfect in about a month.

On June 9th of the same year she was again admitted, and at one end of the cicatrix there was a large ulcer three inches in diameter, flattened, but slightly elevated, a little excavated in the centre, and sloughing on the surface. The edges of the ulcer in the skin were thin and this structure was in no way infiltrated. The growth had been increasing the last few weeks. This growth was removed June 15th, and, as before, a wound with apparently a perfectly healthy surface was left. In this operation some of the fibres of the gluteus maximus muscle were removed, as the new-growth dipped in between its fibres. The section was opaque white, lobulated, and between the lobules the muscular fibres of the gluteus muscle extended. Bands of fibre-tissue, probably remnants of fascia, traversed the surface of the section between its lobes. It was not very vascular. The elementary structures of this secondary development were elongated, fusiform, nucleated cells.

For two or three weeks the wound continued to heal, but before the expiration of a month it was apparent that the disease was re-established in all its force. A new-growth was developed; it soon ulcerated, increased rapidly, bled, and discharged freely, until death, which took place in December.

Necropsy.—The body was greatly emaciated and resembled that of a woman of eighty years of age. There was no serous effusion in the areolar tissue of the body anywhere. The right lung was infiltrated with serum posteriorly. There were three tubers of cancer on the posterior surface, each about half an inch in diameter. The left lung had not so much serum in it, but at its posterior border was a single tuber of carcinoma. This tuber was about one inch in diameter, and the tubers projected into and above the plane of the pleura.

The liver was large, soft and fatty, but there was not a tubercle of cancer therein.

Both the kidneys were very large, hard, firm, and slightly granular. The tunic adherent.

The spleen very large.

There was not a trace of any kind of disease in any of the lymphatic glands anywhere.

On the posterior wall of the uterus was a fibrous tumour of the ordinary kind, and very easily enucleated.

I removed three of the new-growths from the neighbour-

hood of the right hip-joint, which were imbedded there, and growing into the intermuscular fat, and close to the disease in the gluteal region. Also two of the subcutaneous tumours, They were all identical in structure and appearance.

We may deduce the following conclusions from a perusal of the cases related:

1. That the elementary tissues comprising the fibro-plastic growths differ from those entering into the composition of the tumours called carcinoma.

2. That the natural history of the fibro-plastic growths is different from that of carcinoma.

3. That the fibro-plastic growths may recur at the primary site of the new growth or in its immediate neighbourhood.

4. That, unlike carcinoma, there does not appear to be a disposition to the production of fibro-plastic growths in any of the viscera of the chest or abdomen.

5. That when secondary growths are developed in those organs, it will probably be carcinoma.

6. That the glands of the lymphatic system do not become secondarily involved in disease, with the fibro-plastic growths, as they do with carcinoma.

7. That amputation of a portion of a member will not in every case prevent the reproduction of fibro-plastic growth in the stump, even although a joint intervene between the seat of the primary development and the stump.

8. That excision of a primary fibro-plastic growth may be undertaken with a better chance of the eradication of the disease than follows the removal of carcinoma.

9. That by the reproduction of a fibro-plastic growth, and as the result of changes taking place in the tumour itself, death may ensue without the viscera being affected by any organic disease.

10. That the progress of the disease is slower than carcinoma; that is, that the time occupied by the development of the recurrent growths may extend over a very long series of years.

11. That the fibro-plastic growths are developed at a somewhat earlier period of life than carcinoma.

12. That they appear to be closely in relation with fasciæ,

and very often to spring up in those parts of the body where the fascial envelopes or tendinous aponeuroses are developed in the most prominent manner.

13. That they always form circumscribed lobes or masses, and never infiltrate the tissues of the organs of the body like carcinoma so frequently does.

Analytical Table of Cases.

Age.[1]	Sex.	Site of primary growth.	Age of primary growth.	Excision repeated.	Survived first operation.	Survived discovery of disease.	Cause of death.[2]	Case.
30 to 40	M.	Thigh.	Some years.	...	...	...	...	I
27	F.	Neck.	14 years.	...	...	...	...	II
19	F.	Leg.	6 months.	Yes, and amputation.	...	...	...	III
15	F.	Thigh.	1 year.	17 times.	8½ years.	9½ years.	Pyæmia.	IV
30 to 40	M.	Scapula.	Some months.	7 times.	5 years.	6 or 7 years.	Pyæmia.	V
33	F.	Thigh.	5 or 6 years.	Twice, then amputation.	1 year.	6 or 7 years.	Exhaustion.	VI
13	F.	Thigh.	7 years.	...	5 weeks.	7 years.	Exhaustion.	VII
34	M.	Leg.	14 months.	Amputation	...	...	...	VIII
48	M.	Leg.	18 months.	Amputation.	11 days.	18 months.	Pyæmia.	IX
35	F.	Leg.	6 years.	4 times, then amputation.	2 years.	8 years.	State of new growth.	X
24	F.	Neck.	2 years.	...	...	...	...	XI
20 to 30	M.	Back.	10 years.	Yes.	...	...	...	XII
13 or 14	M.	Forearm.	6 or 7 years.	...	...	...	...	XIII
50 to 60	F.	Diffused.	10 years.	Yes.	10 months.	11 years.	State of new growth.	XIV

[1] The age stated in this column is that of the patient at the time the disease was first observed.

[2] In this column, when not otherwise stated, the patient was alive and free from disease when last seen.

PLATE I.

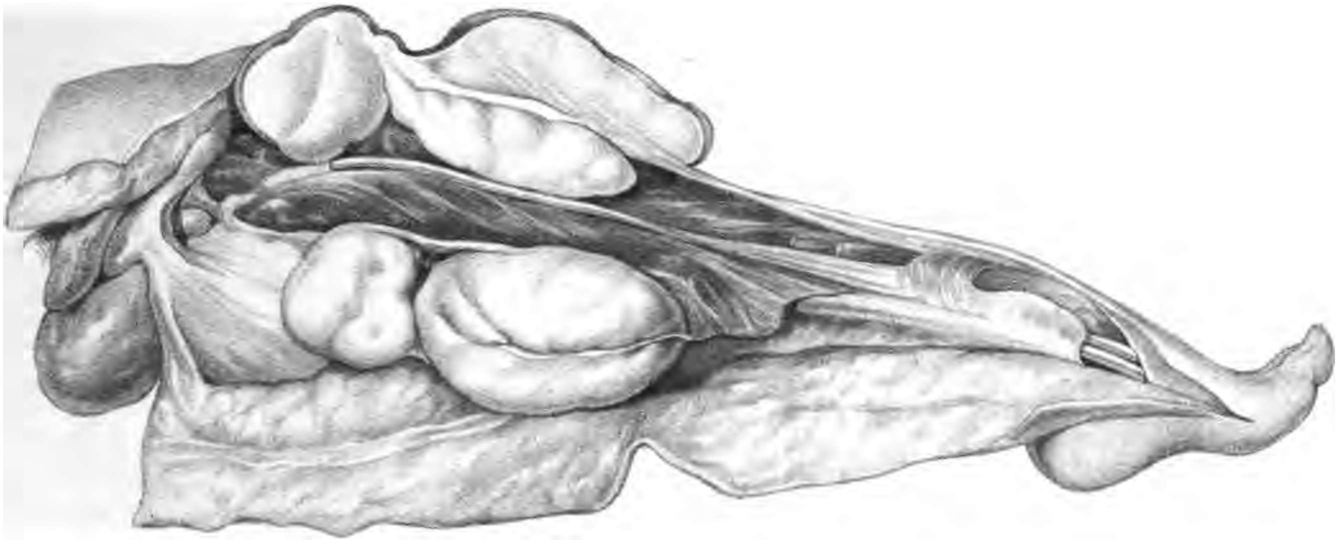
This illustrates Case II. In the detail of the case a full description of the tumour is given.

PLATE II.

This illustrates Case X. It represents a dissection of the limb after amputation. A section has been made of the new-growths, to show the manner in which they were connected with the fascia and some of the tendons of the muscles in the front of the leg.

Plate I.

Plate II.



CONTRIBUTIONS

TO

DENTAL PATHOLOGY.

By S. JAMES A. SALTER, M.B., F.L.S., &c.

I. On the Shedding of Teeth and Exfoliation of the Alveolar Processes, consequent upon the Eruptive Fevers.

During the past few years I have had under my care, principally among the out-patients at Guy's Hospital, a number of cases in which necrosis and exfoliation of the alveolar processes of the maxillæ, accompanied by shedding of the contained teeth, has been one of the secondary consequences, resulting from attacks of the eruptive fevers—scarlet fever, measles, and smallpox. These cases have been so singularly uniform in their origin, course, and entire history, that, though following different forms of eruptive disease, they would seem to have a generic identity: indeed, so similar have they been, that it would be impossible, from a mere inspection of the patient during the period of exfoliation, to have any idea as to which of the eruptive fevers had preceded the then condition—a circumstance which, while it simplifies the description of the several cases, seems to indicate that the immediate cause at least, whatever it may be, is common to the several forms of eruptive fever after which this condition occurs.

But though there is so complete a similarity in the cases themselves, the proportion in which they occur, as sequelæ to the previous fevers, differs very considerably. After scarlet

fever I have had some eight or ten cases, after measles three or four; and after smallpox only one. These figures, referring as they do to sources of observation, combining private practice with a large population of poor who seek assistance at Guy's Hospital, and this extending over a period of six years, may probably be taken as at least an approximation to an expression of what is the relative frequency with which such consequences succeed the different eruptive fevers respectively. The much more numerous examples of bone-exfoliation and tooth-shedding after scarlatina than after rubeola, especially when we consider the more general occurrence of the latter disease than the former—that almost all children have measles, and that perhaps the majority escape scarlet fever—would seem to indicate that the cause of this morbid change is less common and less intense in rubeola than in scarlatina; and this idea is quite in keeping with what I believe to be the true explanation of these cases, and the nature of their essential cause. To this I shall refer more particularly presently.

As I have said, these cases are all singularly alike, and thus the narration of one case will convey a good idea of them all. Take for example the following:—About two years since a poor woman brought her child to me among the out-patients at the hospital, suffering from this tooth-shedding and necrosis of the lower jaw. The child's history was this:—She was a remarkably healthy little girl of five years old; about two months previous she had a mild attack of scarlet fever, which had run its course, and passed off without any untoward symptoms: her recovery was complete, and her health restored to its usual vigour. A few days before the mother applied at the hospital, she had, for the first time, noticed that the child's breath had become offensive, and, upon examining her mouth, had discovered appearances for which she now sought advice. The child now looked in remarkably good health, was rosy and robust, and all she complained of was a slight discharge from the edge of the gum on the left side of the lower jaw, at a part corresponding with the temporary molars, and of some slight pain in that region. Upon inspecting the mouth, it prepresented characteristic appearances with which I was quite familiar: both on the inside and outside of the temporary

molars, on the left side of the lower jaw, the gum was stripped for the depth of about the eighth of an inch, leaving bare so much of the alveolus, while, from within the edge of the mucous membrane, which was red and tumid, oozed a discharge of pus; and the odour of the mouth was fetid. It was particularly observed that there was no thickening of the jaw, and no effort at the formation of supplemental bone; neither was this necrosis of bone associated with fistulæ or sinuses; the discharge of pus coming simply from the edge of the gum, where it had pealed from the alveolus. The mother of the child did not associate this condition with the previous attack of scarlatina, and was somewhat surprised when I asked her *which*[1] of the eruptive fevers (naming them), she had recently suffered from. In answer to my query, she described the mild attack of scarlatina, which I have already mentioned.

I directed that nothing should be done in this case beyond the occasional washing of the mouth with a dilute solution of the trishypochlorite of lime, and that the patient should see me again in a week.

On presenting herself at the appointed day, the pealing of the gum from the alveolar process was found to have progressed considerably, not laterally, so as to involve bone corresponding to other teeth, but simply stripping more from the bone already partially laid bare. It was now found, too, that the same series of changes had commenced on the other—the right side of the lower jaw, and to exactly the same extent of lateral boundary, though as yet it had made but slight progress. This state of things gradually and uniformly progressed; the left side being in advance of the right—the discharge increasing, and the odour of the mouth becoming more offensive, till about six or eight weeks had elapsed, when the sequestrum on the left side commenced to loosen, and in a few days was readily removed by a pair of dressing forceps, accompanied by the contained teeth. After the sequestrum was removed, it was found that the base of the jaw was still entire, and the integrity of the maxillary arch unbroken; the bone

[1] When one of these cases comes to the hospital, so characteristic are they, I always ask the parent or attendant who has charge of the little patient—"Has this child recently had scarlet fever, or measles, or smallpox?" In no one instance have I had a negative answer as to one or other of them.

having ulcerated across beneath the loculi, occupied by the forming bicuspides. The now exposed surface exhibited bleeding granulations, which speedily healed. In about a fortnight the same occurrence took place on the opposite side of the jaw, without any variation in the attending circumstances.

The accompanying figure (fig. 1) is an illustration of the first sequestrum. It will be seen, that it involves, at least, two thirds of the depth of the jaw, and necessarily includes the forming bicuspids; its jagged inferior margin shows that the base of the bone has escaped the necrosis.

Fig. 1.

Sequestrum of inferior maxilla, with first and second temporary molars, and containing the immature successional teeth—the bi-cuspids, shed after scarlet fever.

Fig. 2.

Second superior temporary molar, with the corresponding bicuspid crown, which were shed, accompanied by minute sequestra of alveolus, after an attack of measles.

This history may be taken as a typical example, and as illustrating the ordinary course and issue of these cases. Uniform, however, as they are in all essential particulars, they are, nevertheless, subject to considerable variations in degree of severity. Thus, in one case, which was under my care at Guy's, not only were the corresponding sides of the same jaw attacked, but after the sequestrum and contained teeth had been cast off from the lower jaw on either side, the same occurred in the upper, so that all the eight temporary molars, and all the eight immature bicuspids, with their containing alveoli and loculi, were exfoliated. This was the most severe example I have had; it was after an attack of scarlet fever. On the other hand, in a slight case, the slightest I have seen, only one temporary molar was shed, with its corresponding immature bicuspid, and the bone that was exfoliated was so small in amount—a few little thin plates

of alveolus—that it seemed hardly sufficient to allow of the escape of the dead teeth. This was one of the examples in which measles had been the previous eruptive fever. An illustration of the shed molar and bicuspid will be found at a previous page (fig. 2).

I will not further dwell upon individual cases, but briefly detail what has been the salient and common characters of them all, as far as my own observation has gone.

The first evidence of exfoliation has always been apparent within eight or nine weeks after recovery from the eruptive fever, usually within four or five. It has never been preceded by swelling or pain, or accompanied by periosteal abscess; the suppuration always occurring at the part where the gum peels from the alveolus, which appears to be the simple method of exposing the dead bone.

It has happened more frequently in the lower jaw than the upper, and when in both, first in the lower.

Whichever jaw has been the subject of the exfoliation, it usually occurs on both sides, either coincidentally, or in rapid succession; its tendency is to be symmetrical.

The severity of the previous attack of fever seems to have no relation to the subsequent exfoliation—a very light attack of eruptive fever may be followed by a considerable exfoliation, or the reverse: sometimes it is associated with other secondary symptoms, more often not; indeed, it has seemed to me to have generally occurred in very healthy children.

The age at which these exfoliations have occurred is worthy of especial note. It occurs during the time that the most active tooth-development is going on in the jaws, and when all those parts are undergoing the most rapid nutritional changes—about five or six years of age. From four to eight years are the extremest limits I have seen.

It is not a little remarkable, that in *every* instance that has come under my observation, the temporary molar or molars, and the corresponding bicuspid or bicuspids, with their containing alveoli and loculi, have been the parts to suffer.

In no one case has the shedding of teeth been confined to the temporary set; the successional (bicuspids) have always been involved, and shed also.

What *may be* a coincidence—I have most frequently found these

cases among the poor; and what, no doubt, *is* a coincidence, my patients have generally been girls.

I have not draw up this little memoir with any idea of its great importance, or because I can prevent or cure the disease in question, or because it is itself really novel (though I am not aware that it has been described by authors, other than by the occasional publication of isolated cases, without any intelligible interpretation), but I have thought it worthy of consideration, from the fact that so many cases have, probably accidentally and out of proportion,[1] fallen under my care, and that too where the secondary consequences have resulted from all three of the primary (eruptive fever) causes, thus giving me an opportunity of collating and comparing the several cases, and of deducing from their common characters a common explanation of their nature and their cause, and which I believe is to be found in a rational interpretation of the three following propositions:

1. Certain diseased conditions of teeth are sufficient to produce their own shedding, by the necrosis and exfoliation of their containing alveoli.

2. In the eruptive fevers the poison of the disease spends its chief force upon the tegumentary system.

3. The teeth are modified papillæ—are members of the tegumentary system.

These propositions are acknowledged truths. By applying them to the cases under consideration, I submit that they explain them—that they solve the difficulty of establishing one similar *immediate* cause as arising from three several *primary* ones, and show why these cases of tooth-shedding and alveolar necrosis, produced by three forms of eruptive fever, may be identical in aspect, identical in course, identical in issue.

The first proposition—*that diseased teeth may cause exfoliation of alveolar processes, with their own shedding,* is familiar

[1] From the number of cases that have been under my cognizance, I feel sure that I have fortuitously had many more than should have been my share, or I think this condition could not have escaped record, by previous writers, as one of the sequels of the eruptive fevers—common to them all. So numerous have my cases been, that once or twice they have seemed almost epidemic: on one occasion, about three years since, I had five under my care at once, three of them coming to me for the first time on the same morning.

to all practitioners of dental surgery; and all works on that speciality, from the days of Hunter and Fox to the present time, have contained examples of such cases. And when we see the intimate anatomical relation existing between the teeth and their bony sockets, and that the periodontal membrane of the one is continuous with the periosteal membrane of the other, and, indeed, that in the sockets of the teeth themselves they are the same, it is rather to be wondered at than otherwise that necrosis and exfoliation of bone is not a more common result of the intense inflammation to which diseased teeth occasionally give rise. Why, in any particular case, exfoliation should occur, and why not in another, no suggestion has as yet been made; but it would certainly seem that there *must* be some specific difference of cause or character in the inflammation, which should determine the issue. Now, it has been shown by Mr. Simon, in an admirable[1] lecture delivered by him on diseases of the jaw, resulting from inhalation of phosphorus fumes, that in these cases it is by the specific poisoning with those fumes of the tooth-pulp, exposed by caries of that tooth, the necrosis of bone and shedding of teeth with it, is brought about. It is the poisoning of the tooth-pulp that is the starting-point from which all the other morbid phenomena take their origin. Nothing can be clearer or more logical than the premises and reasoning upon which he has established this truth. And it is in such cases that, I believe, we have the nearest analogues to those we are now considering.

Of the second and third propositions I need say nothing; they are self-evident, and universally received. But, let us apply them to the cases in question.

Here, then, we have a set of cases, in all of which a specific poison attacks the tegumentary or dermal system—of which system is clearly the emunctory of the *materies morbi;* for we see that in them the cast-off material of the derm is the poison, and the vehicle by which that poison is propagated. Here we have a set of dermal organs—the teeth formed, and the teeth forming—exposed to the same poisoning influences as the other dermal organs, but with this anatomical difference, that they have not the opportunity of

[1] Clinical Lecture by John Simon, F.R.S., on Diseases of the Lower Jaw produced by Phosphorus Fumes. 'Lancet,' 1850, part I, page 41.

casting that poison from their surface. In all these cases, be it remembered, the disease has manifested itself at a period of life when the whole dental system is in a state of the most exalted nutrition, more so than at any other time, and consequently, then, more abundantly circulating the poisoned blood: again, the forming tooth, as well as the formed, is always shed; and be it further remembered, that after that particular eruptive fever (scarlet fever), which more than the others affects the dermal system, by far the largest number of cases have occurred.

From all these premises the inferences I draw are these: That the phenomena we have been considering commence by fatal damage done to certain of the teeth and forming teeth during the eruptive stage of the fever; and that the bone-necrosis, and casting off of them and their containing alveoli and loculi, is a secondary and contingent consequence; that the *materies morbi* affects them by virtue of their being dermal or tegumentary organs, and that, blighted and irretrievably destroyed, they light up in the alveolar periosteum an inflammation which, while it is destructive, is curative; while it destroys the bone it accomplishes the casting off of effete and dead organs.

Such an explanation appears to me to be in keeping with the entire history of all these cases—to place them, as their common aspect seems to indicate, in one category. It gives a rational interpretation of the singular uniformity of their course and issue: without such explanation they appear to me to be unintelligible.

II. On Warty Teeth.

The occurrence of teeth with complicated foldings of surface, or compound papillary projections of the crown, and to which I have given the name of "warty teeth," is interesting, not only from its rarity, but from the morphological peculiarities which it involves, and some not unimportant practical considerations which it suggests.

The literary history of this subject is, I believe, confined within very narrow limits. The earliest account of this malformation with which I am acquainted, was published in

Vienna, by Wedl, in his 'Pathological Histology,' in 1853. Another example that has been described was published by myself, in the sixth volume of the 'Transactions of the Pathological Society of London;' and, beyond these two, I am not acquainted with any example of this condition of which an account has been recorded.

Four other instances have come under my notice. One which occurred in the practice of a metropolitan surgeon of eminence, about the year 1848, and to which I have briefly alluded in my paper in the 'Pathological Transactions;' two specimens which have long been in the museum at Guy's Hospital; and another case which has very recently come under my own observation.

Wedl's specimen evidently consisted of a modified wisdom-tooth, in which the entire organ participated in the monstrous growth. It was a large nodular complicated mass, occupying the angle of the jaw behind the second molar. In structure it consisted of a modified dentine and enamel. For further particulars of this case and specimen, the reader is referred to Mr. Busk's translation of Wedl's 'Pathological Histology.'

In the first case that came under my own observation, the malformed tooth was a superior lateral incisor; the crown of the tooth was well formed and the warty growth was a superaddition. This consisted of an irregular lobulated mass, the size of a horse-bean, of a brown colour, and of a porous, cancellated aspect, looking very like (especially when seen *in situ*) what one might imagine an exostosis from the edge of the alveolus denuded of periosteal covering. The surface was extremely irregular, exhibiting every species of complication—foldings, projections, pores, interspaces, and depressions.

This specimen gave me an opportunity of ascertaining what was the true character of the structure, and upon examining a section I found that it consisted of papillary projections and villous foldings of surface, into which all the proper elements of the tooth-crown enter, each papilla or villus being composed of a mass of dentine clothed by enamel, and containing within it a pulp-cavity or vascular canal; and I was, by my section, able to trace the elaborately ramifying pulp-cavities of the warty growth as common and continuous with that of the body

of the tooth itself, proving beyond doubt that they had originally been developed from a common pulp mass.

The case which I have mentioned as having occurred in the practice of an eminent metropolitan surgeon, was this:

"A young man, æt. 20, was admitted into a metropolitan hospital, having a mass resembling bone within the mouth, on the upper surface of the horizontal ramus of the lower jaw, immediately behind and in a line with the second molar tooth on the right side. The mass had gradually been rising in the mouth for some time, and was, when the patient was admitted into the hospital, as large as a small walnut; and, by its continued projection, had gagged open the mouth. To all outward appearances this mass very much resembled a piece of porous bone denuded of periosteum, and this, indeed, it was considered to be."[1]

Unfortunately, acting upon this opinion, for the extirpation of the mass, the angle of the man's jaw was removed. By this means the integrity of the maxillary arch was destroyed, and the pterygoid muscles of the two sides now acting independently and without antagonism, the detached portions of jaw were so drawn from their normal position, that efficient mastication was for ever at an end.

This tooth might have been extracted by a pair of forceps.

A section made through the mass at once disclosed its nature, and "showed that it was really a malformed tooth, and that the supposed exostosis was the crown of the wisdom-tooth in a state of warty complication. The fang of the tooth was almost normal, and was seen in the section to be implanted in an appropriate socket, and containing a single pulp-cavity."[2]

The specimen figured at 1*a* and *b*, in the accompanying plate (Pl. I), is from the museum at Guy's Hospital. It is a superior dens sapientiæ, and the warty excrescence consists of a small conical mass attached to the side of the tooth; it is irregularly folded in surface, and the enamel which covers it is particularly white—more so than in either of the other specimens I have seen. The form and size of the little mass

[1] 'Transactions of the Pathological Society of London,' vol. vi, p. 176.

[2] Loc. cit.

will be best understood by reference to the figures, which represent it in two aspects.

The other specimens from the Guy's Museum (Pl. I, fig. 2), is a superior lateral incisor with a considerable warty projection on its outer side and back part. The mass is irregularly folded and yellowish in colour, and much resembles (though not in position) the specimen described by me in the 'Pathological Transactions.' The front of the crown of the tooth is well formed, but on the back the outer half is swollen out, and forms part of the mass.

As these specimens belong to the hospital museum, I have not had an opportunity of examining the structure of the warts by microscopical sections; but their enamel is continuous with that of the crowns of the teeth, and it is quite obvious that they bear the same relation to them as in the case examined by me, and published in the 'Transactions of the Pathological Society,' to which I have just referred.

The history of these specimens is unknown; but the lateral incisor, from the large size of the pulp-cavity, clearly belonged to a child, and was probably removed, from its unsightliness.

The remaining specimen I have to describe has come into my possession very recently. I removed it from a patient of my own. A gentleman of about thirty-five years of age applied to me during the past summer, suffering great pain in the angle of the lower jaw, on the right side, extending down to the shoulder, and he complained of swelling behind the wisdom-tooth on that side. On examining the mouth, I found a small bone-like looking mass imbedded in the mucous membrane immediately behind the dens sapientiæ, scarcely projecting above the surface, and surrounded by irritable bleeding granulations, having exactly the aspect of a piece of necrosed bone. It was rather loose, and I readily removed it with an elevator. Upon scrutinizing it with a lens, it proved to be a small supernumerary tooth with a curiously warty crown.[1]

[1] Since the above has been written, this patient has returned to me with a second supernumerary tooth in precisely the same place—it having come upward and forward since the removal of the previous one. This tooth consists of a thin plate of dentine, about half the size of one's little finger-nail, and on its upper surface are three projecting nodules of enamel.

The tooth is represented in the accompanying plate, of natural size, and variously magnified so as to display its form and character. It is a conical mass, consisting almost entirely of fang, and on the flat upper surface are numerous papillæ of enamel, perfectly white, and, when seen magnified, look like the ends of many fingers placed together. This is well seen in figure 4 of Plate I. The edge of the crown, if it may be so called, is eroded by absorption from contact with the granulations that surrounded it, and on the right side of the more magnified figure will be seen a beautiful shell of enamel, from which the dentine has been absorbed, leaving the hollow outer skeleton, looking like the two valves of a half-open bivalve molusc shell—like the thin white valves of a Pholas sticking from a rock. The object is extremely beautiful under the microscope.

It is worthy of note that the teeth which have been the subjects of this malformation are three dentes sapientiæ, two upper lateral incisors, and one supernumerary tooth—teeth which, above all others, are most liable to aberration as regards their form, their position, and indeed their presence.

The morphological explanation of these specimens is obvious—indeed there can be but one method of accounting for them. Since we know that the superficies of a tooth is the part first formed, and that it corresponds in every particular in shape with the original formative pulp, so it follows that the pulp must in these cases have borne the same relation to a normal pulp as a tegumentary wart does to normal papillary structure. Such a condition is abnormal in the human subject, but it cannot strictly be called morbid, for it is merely a morphological deviation with which analogues may be found in the dentition of lower classes of vertebrate animals. Thus, for the form of complication which consists of lateral villous foldings of surface, an analogue may be found in the teeth of the Labyrinthodon; while in the columnar denticles of the compound molars of the great African wart-hog (Phacochærus), or still more in the pectinated teeth of the Flying Lemur (Galeopithecus), we have forms which are analogous to those teeth in which the complication of surface consists of vertical papillæ.

One or two practical remarks I would wish to add. It

should be borne in mind by surgeons, that teeth occasionally exhibit such change of form and aspect that they can no longer be recognised as teeth, and that they may (as has once happened) be mistaken for necrosed bone; and that the removal of the ungainly mass does not require the scalpel and the saw, but may be accomplished by the forceps.

Again, the surgeon-dentist should recollect, that where there is only a partial warty malformation, appended to an otherwise normally formed tooth the excrescence, especially if near the neck of the tooth, may be readily confounded with a mass of tartar. Such a mistake would be fatal to the tooth; the thin laminæ of the spongy mass would readily yield to the force of the scaling instrument, and the pulp-cavity would be opened.

As regards the treatment of these cases, much must depend on degree, and the particular tooth affected.

If the tooth be a supernumerary one, as in my last case, it should, of course, be removed: if a malformed wisdom-tooth, and especially in the lower jaw, and, when of a size to produce pain or gagging, it should be removed: if an incisor be the malformed tooth, and if the malformation be conspicuous, as in figure 2 of Plate I, it should be removed and replaced by another; but, in so slight a case as the one represented at figure 1, where the excrescence is so small as to produce no inconvenience, and in a position (on a molar tooth) where it could not disfigure, there would be no object in its removal.

III. Polypus of the Tooth-pulp.

The minute anatomy of this morbid condition has, I believe, never been described, and there are, too, some concurrent circumstances so generally, and, as I think, constantly and necessarily associated with it, and also unrecorded, that a brief account of them might not be undesirable.

Polypus of the tooth-pulp is an hypertrophy (with structural modification) of the pulp—the dentine-forming pulp of the permanent tooth.

The existence of this condition, though by no means rare, appears to have been overlooked till a comparatively recent

period. Neither Fox nor Hunter refer to it in their great works on the teeth, and I believe Mr. Bell, in this country at least, was the first to describe it.

Mr. Bell, under the title of 'Fungus Growth of the Pulp,' gives a very accurate and correct account (as far as the means of investigation then went) of the disease under consideration.

Mr. Bell remarks: "These tumours of the pulps are of two kinds; the one is exquisitely painful, retaining in this respect, as well as in (apparent) texture, the character of the structure from which it is derived; the other is almost totally insensible. The first rarely increases to such an extent as to fill the whole cavity which has been made by decay, perhaps, because it is seldom suffered to remain very long without being removed with the tooth, on account of the pain to which it gives rise. It is of very rare occurrence compared with the second species, to which I have alluded, and which is by no means uncommon."[1] I allude to, and quote this passage, for the purpose of pointing out and separating the mere sensitive hypertrophy of the pulp from that form of hypertrophy with altered structure which is the subject of this paper.

I would only remark, that I am led to consider the first as a mere hypertrophy, without altered structure, because it retains the aspect and the intense sensitiveness of the pulp; and I would add, that, though the description, by Mr. Bell, of this little tumour accords exactly with what I have seen, still I have never observed this condition as the result of dental caries, but always as the sequel of fracture of a tooth when the pulp has not received that preparation (so to speak) which, in the form of a rapid, sodden, soft general caries, always, I believe, antecedes the growth of insensitive polypus—the subject of this paper.

I have almost always found that this condition, when present, occurs in young people, and in those in which the teeth are imperfectly calcified, presenting that peculiar globular calcification in which the substance of the dentine becomes rapidly sodden with saliva, and carious without limit from the enamel to the pulp—the pulp, in all probability, receiving some influence or impression from the presence of that fluid, before

[1] Bell 'On the Teeth,' 2d edit., 1835, p. 207.

it is laid bare by the breaking away of the carious dentine—which thus lights up a series of changes in it different from those which occur as the result of ordinary caries. Nor, I believe, is this association of polypus of the pulp with this form of caries and its occurrence otherwise than an essential or at least a contingent circumstance. It seems probable that the sudden and complete saturation of the dentine with saliva might reach the pulp previous to its undergoing intrinsic calcification, while, at the same time, the crown still affords a partial protection; at least, it protects from attrition with hard and crude substances. We may here imagine an influence bearing on the pulp sufficient to alter its surface action, not of a nature to lead to the formation of dentine of repair, or intrinsic calcification, nor such as would produce the intense inflammation of the pulp which follows the fracture of a sound tooth. This may, possibly, be the reason why this character of tooth and this form of caries are so often associated with polypus of the pulp; and if this be granted, it is obvious why it so constantly, when present, shows itself early in life; for teeth thus imperfectly calcified, seldom long resist the chemical and physical influences to which they are exposed in the mouth, but early fall victims to general soft light coloured caries. But, whether the interpretation I have suggested be the correct one or not, the fact of such an association of character of tooth, and period of life with polypus of the pulp is, I feel convinced, almost, if not quite constant, when the disease is present.

The physiological phenomena displayed by polypus of the pulp are very remarkable, as regards both the pulp itself and the tooth, and their oppositeness to the whole train of circumstances which accompany the ordinary inflammation of the pulps dependent on caries, odontalgia, lymph deposit on fangs, alveolar abscess, &c., does not appear to have been sufficiently appreciated or enforced.

The pulp sprouts into a mass having very much the aspect and about the same sensitiveness as the surrounding mucous membrane—the gum. The pulp never undergoes intrinsic calcification; nor have we any evidence that dentine of repair is ever produced. The tooth is never the subject of odontalgia. Alveolar abscess has, I believe, never been seen associated with polypus of the pulps, nor are there to be found the

evidences of periosteal inflammation around the extremities of the fangs, so constant and so abundant in cases of ordinary caries. Indeed, the phenomena of the two conditions are entirely opposed to and antagonistic of each other. They may, perhaps, not inaptly be compared to inflammatory action where it can—and where it cannot get rid of its results, to, for instance, a granulating wound that sheds its pus, without pain, distress, or irritation, and an unopened abscess with all the local and constitutional irritation and distress that accompany it. Or, perhaps, the semblance is more complete in comparing the two conditions to two glands, in one of which the organ finds relief in *desquamative issue*, and in the other in which desquamative products are pent up and can receive no such relief. In the pulp-polypus, the swelling up of the tumour, unrestrained by compressing walls, and the free shedding of its purulent or epithelial surface-products, are probably why its presence is unaccompanied by local pain or constitutional irritation.

The *character* and *history* of this tumour are very constant, and subject to little variety.

It begins, as I have observed, by the exposure of the pulp in a tooth that is imperfectly calcified, that does not ache, and that has not ached; the tumour usually, though not always, fills the cavity, and is limited by it and the opposing tooth in the other jaw. It is insensible, at least as much so as the gum. With the exception of occasional variation in size, temporary, and like a sort of erection (often from cold and dyspepsia), it seems to remain quite passive. It occurs, as I have observed, in young persons almost altogether, and more often in the molars, especially the first, than in other teeth. It has been my experience (but perhaps this is a coincidence) to have more cases in young women than in young men. It frequently exists in many teeth in the same individual, and this is quite in keeping with the idea that it is dependent on an imperfect character of original tooth-structure. And I believe it is very generally associated with soft complexion, fine hair, small teeth, and general tegumentary feebleness.

Histological structure of polypus.—I am not aware that there is any published account of the histological structure of this tumour. During the past few years I have examined

every specimen I could obtain, and have submitted a large number to microscopical scrutiny. The results of my investigations at first were not at all what I expected, as I found two distinct characters of structure which seemed irreconcilable with each other; more recently, however, I have had another specimen, which seems to link the two together, and show that the one is merely an advanced development of the other, and, indeed, its ultimate and legitimate issue.

In the great majority of specimens I have examined, and, indeed, with only two exceptions, the polypus has had exactly the appearance of a mass of granulations, such as one sees by examining the granulations of a healing wound. The more superficial portions have consisted entirely of cells about the two thousandth of an inch in diameter, held together, and at the same time separated by a clear unintelligible medium—a nearly homogeneous blastema; some of the cells have seemed absolutely free on the surface, others apparently shed from the surface. Deep in the substance of the polypus the cells appear to have been developed into an immature fibrous tissue; and looping towards the surface are many capillary blood-vessels.

I have always been struck with the similarity of the superficial cells to those which are found in such multitudes in the substance of a healthy tooth-pulp—the "granules" of Purkinge, which may, perhaps, have been suggested by the coincidence of their position. I never saw any of the columnar cells which constitute the normal surface of the pulp—the "membrana eboris" of Kölliker.

Is the pulp, in this condition, to be viewed as a mass of granulations, of granulations springing from a wound—for a wound the exposed pulp (a sub-basement structure) must certainly be considered?

Are these spherical cells, appearing here like the cells of ordinary granulations, the same rudimental elements, the "granules" of Purkinge, that are found in the normal pulp, modified, perhaps slightly, and in their future destiny to be further modified by the new circumstances in which they are placed?

I am inclined to answer both these questions in the affirmative.

In the two specimens in which a higher degree of development had taken place, the surface of the tumour had assumed the character of mucous membrane: in one scarcely to be distinguished from that of the gums or the palate; in the other it seemed imperfectly developed, and in a transitional condition.

These are the particulars of the first of these examples; and the accompanying plate (Pl. II) represents some of its histological details. The tooth was a first upper molar, in the mouth of a young lady, who had long been aware of its presence; the cavity of the carious tooth gave some annoyance, and it was consequently extracted.

I removed the tumour from the tooth, and made a section of it at right angles to the surface, though, from its softness, there was probably some dragging, and consequently obliquity of incision. Upon examining the cut surface with a lens, it appeared that the tumour was covered by a thick cuticular epithelium, and beneath this was a series of papillæ. This is indicated in fig. 3, in the accompanying plate: the extreme thickness of the epithelial covering, and the irregularity of the papillary line, are probably the result of obliquity of section. The histological elements of this structure, as seen by high powers of the microscope, exhibited, in the closest manner the appearances of the mucous membrane of the gums and palate. The epithelium was cuticular on the surface; it became softer, and rounder and smaller, on proceeding downwards and inwards, while that resting on the numerous papillæ had the appearance of that on the gum and skin in a similar situation, and functioned in the same manner, under the action of caustic alkali. The basement membrane, as seen by maceration and the action of *liquor sodæ*, was sharp and very definite, and folded in a papillary arrangement, and the only difference between it and that of the gum was the irregularity of form and size of the papillæ. Each papilla appeared to contain a capillary loop. In all respects this structure so closely resembled that of the gum (familiar to all histologists) that I need not further describe it, but refer the reader to the accompanying plate, which contains illustrations sketched by myself from portions of the specimen. After the above observations were made, I carefully examined every specimen I

could obtain, and, for a long time, the only appearances I found were those resembling ordinary granulations, until, at length, I obtained a specimen which seemed intermediate between the two forms. The surface of this tumour exhibited (as seen by high magnifying powers) large numbers of granulation-cells, and also pale indistinct epithelial cells—cells like epithelium, that has been rendered partially clear by the action of dilute alkali; and the nuclei of this epithelium so closely resembled the globular granulation-cells, that it seemed as if many of the latter, functioning as nuclei, had been clothed upon by an investing periplast, thus producing epithelium. Moreover, in several portions that I examined, I discovered a folded film, which appeared to be an immature basement membrane: in some parts it loomed very obscurely among the cells, but, in others, I found true papillary outlines, sharp and *prononcé*. This limitary sheet was overlaid by the pale epithelium (pale in cell-wall, but not in nucleus,) and seemed to be produced simply by the differentiation of the blastema, in which the granulation-cells had been imbedded. If this interpretation of these appearances be correct, and the superficial granulation-cells do become clothed upon by a periplast, thus forming an epithelium, while, at a certain depth from the surface, the blastema differentiates into a basement membrane, then the relation of the two opposite appearances in different specimens of tooth-pulp polypus is obvious, and is this. In the more general form the tumour is merely a sprouting granulation from a wounded surface; in the rarer form, where it is covered by mucous membrane, the granulations have cicatrized.

Description of Plate I.

Fig. 1. Superior dens sapientiæ, with warty excrescence.
a. Viewed in face.
b. Viewed in profile.

Fig. 2. Superior lateral incision, with warty excrescence.
a. Viewed in profile.
b. Viewed in face.

Fig. 3. Supernumerary tooth from the angle of the lower jaw —the crown represented by papillæ of enamel.
a. Side view, natural size.
b. Side view, enlarged three diameters.
c. View on the top of the crown, showing the papillæ of enamel, enlarged three diameters.

Fig. 4. The same view enlarged fifteen diameters.

Fig 1.

a b

Fig. 2.

a b

Fig. 4.

a

Fig. 5.

b

c

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Description of Plate II.

Fig. 1. Upper first molar, with carious cavity filled by a polypus.

" 2. The polypus removed from the tooth: the tinted portion showing the part represented in section by figure 3.

" 3. Section of polypus magnified about ten diameters. The clear outer area marks the thickness of dense cuticular epithelium; the wavy outline indicates the position of the papillæ.

" 4. Basement membrane of a naked papilla.

" 5. Papilla clothed with inner layer of epithelial cells.

" 6. Sheath of epithelium, shed from a papilla.

" 7. Outlines of various naked papillæ, after removal of epithelium by maceration.

" 8, 9, and 10. Various forms of epithelial cells.

Fig. 1

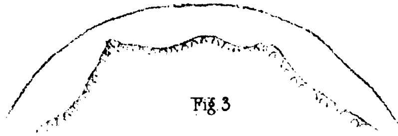

Fig. 3

Fig. 2

Fig. 4

Fig. 5.

Fig 6.

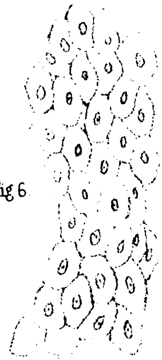

Fig. 7

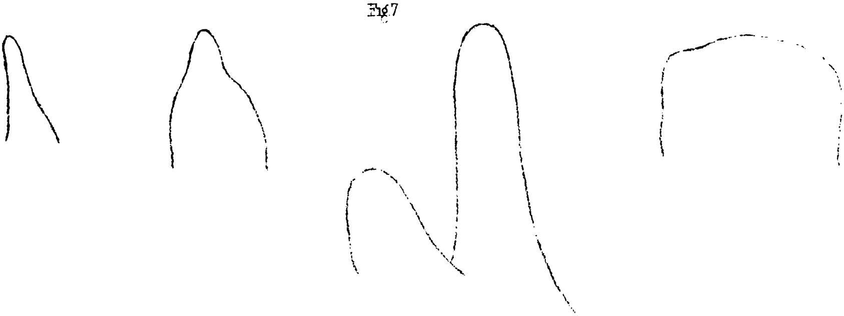

Fig. 8.

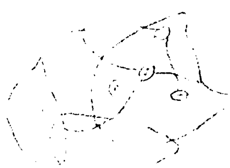

Fig. 10.

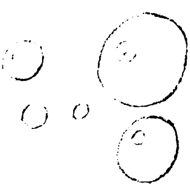

Fig. 9.

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ON THE

ALLEGED SUGAR-FORMING FUNCTION

OF

THE LIVER.

By F. W. PAVY, M.D., Lond.

With the papers that have appeared in previous numbers of the 'Guy's Reports' the title of this communication will appear discordant. Ten years ago it was announced that the liver possessed a sugar-forming function, and the statement was supported with apparently such conclusive evidence that it was soon received as an established physiological fact. I had often performed the original experiments, and with the same result as Bernard. And, until quite recently, so thoroughly did I feel convinced of the truth of Bernard's doctrines, that it never entered my mind to question them. The result of my own observation tallying so completely with the experience of Bernard and others, I entertained no doubt as to the liver being an extensive sugar-forming organ. I looked upon it as sufficiently proved that sugar was constantly being poured to the extent that was believed through the hepatic veins into the general circulation, and I conducted a number of experiments to determine what subsequently b came of it in the processes of animal life. I noticed, with many others, that if a specimen of blood were removed from the arterial system and examined, the indication of sugar was exceedingly slight; whereas, if the life of the animal were imme-

diately afterwards destroyed, the blood collected from the right side of the heart gave signs of a strong impregnation. The inference naturally drawn from this observation was, that sugar became destroyed in passing through the lungs, and I sought to discover the nature of this destruction. It appears, however, from what I have to detail, that our very starting point was untenable. It is not that our experiments come different now to what they formerly did, or that their results have been inaccurately described; but, that inferences have been drawn which, by a further investigation of the subject, prove to be fallacious. It is true that a large quantity of sugar is met with in the liver and in the blood of the hepatic veins and right side of the heart (*after death*) of an animal that has been for some time previously restricted from the ingestion of saccharine materials, but the question to be now entered upon, from the fresh evidence before us is, was there sugar present also *during life?* Does the sugar, in fact, that we meet with in the body of the animal feeder after death result from a *post-mortem* transformation, or from an *ante-mortem* functional operation? The origin and rationale of this question will fully appear as we proceed.

Before entering upon my own recent researches, I will give the following extract, to show the position in which our knowledge stood when I was induced by the unexpected result of a few experiments to give the subject a fresh investigation from the commencement. In the 'Comptes rendus' of the Parisian Academy of Sciences for the 24th of September, 1855, Bernard maintains in the following terms the accuracy of his glucogenic theory, which had been attacked by M. Figuier, who denied that animals possessed the power of forming sugar, and referred that found in the liver of an animal feeder to an external source. A commission was appointed to examine into the views of M. Figuier. But it appears that the grounds upon which his arguments were based were so untenable, and so entirely at variance with the evidence afforded by experiment, that the doctrine of Bernard was rather strengthened than otherwise by the attack that was made upon it.

"Premièrement, j'ai dit dans mon memoire qu'il existe chez les animaux une fonction physiologique en vertu de

laquelle il se produit de la matière sucrée dans l'organisme, parceque le sucre persiste toujours dans le foie et dans le sang chez les animaux carnivores dont l'alimentation ne renferme aucune substance sucrée. C'est là un fait capital; car il y a peu de temps encore, on admittait généralement que le sucre trouvé dans l'organisme était toujours introduit en nature par l'alimentation. Aujourd'hui personne ne discute plus sur cette question, et il reste parfaitement établi, depuis mes expériences, que le sucre (glucose) se produit dans l'organisme animal sans l'intervention des substances sucrées ou amylacées.

"Deuxièmement, j'ai egalement dit que cette fonction glycogenique doit être localisée dans le foie. En effet chez un animal carnivore le foie est en realité le point central d'ou part le sucre pour se repandre dans tout le corps, et, circonstance sur laquelle j'ai particulièrement insisté, le sang qui pénètre dans le foie par la veine porte ne renferme pas de sucre, tandisque le même sang qui sort par les veines hépatiques en contient toujours des proportions notables. On ne pouvait, d'après cela, s'empêcher de conclure que le sucre prend naissance dans le foie dont le tissue est du reste constamment impregné de matière sucrée dans l'état physiologique."

Believing, with Bernard, that sugar was being constantly poured through the hepatic veins into the general circulation, I was prosecuting inquiries upon the nature of the destruction that it was admitted to undergo in the lungs. I endeavoured to see if this destruction took place on injecting recently abstracted right-ventricular blood through the capillaries of the artificially inflated dead lung. I arrived at results which induced me to believe that the presence of fibrine played an all-important part. If I repeat these experiments, I still obtain precisely similar results. But there is a fallacy attending them, arising out of the error under which it would now appear we have been labouring from the commencement. We have to retrace our steps, and see if sugar is natural to the right-ventricular blood of the *living animal*, as has been latterly supposed; and afterwards, if natural even to the *living liver*. Our former experiments infallibly indicate that sugar is met with immediately after death; and the *inference* has been drawn that it is likewise present during life. The

inference, it is true, is a plausible one, but we shall see how far it will stand the test of a strict investigation.

Whilst conducting the experiments on the injection of blood through the artificially inflated lung, I met with such obstruction from the rapid coagulation of the blood when collected after the death of the animal, that I determined to resort to catheterism of the living right ventricle, thinking less time might be taken, and that my experiments might thus prove more successful. I found it easy to pass an instrument through the right jugular vein into the ventricle, and to effect the abstraction of blood, but I did not then obtain it quick enough to prevent its coagulating in the tube and syringe almost before I had time to commence the injection. My first experiments in this way were conducted as far back as February, 1854, and amongst the details of them in my laboratory memorandum book, I find it noticed, that in the three separate instances where blood was removed from the ventricle of the living animal, it did not present what I regarded as the natural reaction of right-ventricular blood, for it seemed to be scarcely at all impregnated with saccharine matter. Notwithstanding this observation was underlined, and accompanied with the remark that it was deserving of further attention, yet, being so possessed of the idea of the accuracy of Bernard's doctrines, I could not bring myself to believe that these specimens of blood formed a representation of the natural condition belonging to the living animal. Although the heart was in each case felt beating against the end of the instrument introduced, and a distinct pulsation was visible in the vulcanized tubing connected with it, yet—astonishing as it may seem to me now—I inclined to the opinion that the blood was not fairly withdrawn from the ventricle, or that I had come in contact with the descending current from the superior cava. In the following June I again removed blood by catheterism, and found it to present a precisely similar condition. But, even now, it did not fully occur to me to question the convictions which so strongly prevailed in my mind as to the truth of the glucogenic theory. Later, however, I began to inquire into the cause of the phenomenon I had noticed, and it was this inquiry that led me to the unexpected results, which, I first

announced in a communication addressed, in January, 1858, to the secretary of the Royal Society. The whole of the facts were afterwards placed together, and sent in as a paper, which was read at the last meeting of the Royal Society, in June.

The first point to be noticed, is, that the removal and examination of blood after death will not supply us with correct information of its condition during life. From an experience of upwards of sixty observations, I am enabled to state that, contrary to what has been recently believed, sugar is only found to the extent of the merest trace in the blood of the right side of the heart, under a natural or ordinary condition during life. The reaction with the Barreswil solution is sometimes so slight as to be liable to be overlooked altogether, unless the test-tube be re-examined after it has been placed aside for some time, to allow any minute floating particles of precipitate to subside.

In my communication to the Royal Society I have given the details of five experiments, where the difference is shown between the blood belonging to life and that removed after death. The blood was collected during life by passing a smallish silver catheter, specially curved for the purpose, through the jugular vein into the right ventricle. By means of a wide glass tube, with a bulbous enlargement holding about an ounce or an ounce and a half upon it, and drawn out rather pointed at one extremity, so as to adapt it with a piece of vulcanized tubing to the end of the catheter, the blood is easily sucked by the action of the mouth out of the ventricle. The mouth answers infinitely better than a syringe, on account of an obstruction being instantly perceived; and when it happens that a valve or anything else is drawn against the orifices of the instrument, a slight movement is sufficient to release it. Whilst the performance of the operation is being effected, it is essential that the animal should be maintained in as perfect a state of tranquillity as possible. For, during violent struggling or a disturbed state of the respiration, the liver is submitted to unnatural compression and congestion—conditions, as will afterwards be seen, which are capable of determining the presence of sugar in the circulatory system, and which thus lead to a vitiated result. In two of the experiments detailed, the catheter had fortuitously perforated the parietes

of the heart, and the blood which was withdrawn had escaped into the cavity of the pericardium. The accident was not indicated by any symptoms manifested during life. It fortunately furnished me with positive evidence that the blood had been derived from the right side of the heart. After the catheterism, the life of the animal was immediately destroyed. The chest being opened, a free incision was made in the right side of the heart, and the blood which escaped into the thorax was collected and defibrinated, and then submitted to a quantitative analysis. In each case, the difference of reaction on testing with the Barreswil solution was of the most striking description. The blood which had been withdrawn from the right heart during life gave the merest trace of indication of sugar; the same indication, in fact, as a specimen of blood which had been previously removed from the arterial system; whilst the blood which was collected after death occasioned an abundant yellow or orange-yellow precipitate of suboxide of copper. The following were the results of the quantitative analyses. The arterial blood and the right ventricular blood removed during life, contained such a mere trace of sugar that, I thought at the time these experiments were conducted, it was unsusceptible of an exact determination. I have since, however, made analyses of other specimens that behaved with the Barreswil solution in a precisely similar manner, and these I will proceed to speak of presently. In the first experiment, the quantitative analysis of the right-ventricular blood after death indicated seven-tenths of a grain of sugar in 100 grains of defibrinated blood. In the second, 65-100ths per cent.; the liver of the same animal examined immediately after death yielding 4·10 per cent. In the third, five-tenths per cent,, and the liver 3·39 per cent. In the fourth, 94-100ths per cent., and the liver 2·45 per cent. And in the fifth, seven tenths per cent., and the liver 2·44 per cent.

I have exercised the greatest care in estimating the quantity of sugar naturally belonging to the blood of the right side of the heart during life. The blood was removed from an animal in a state of tranquillity, and without the exhibition of chloroform. It was defibrinated, and about an ounce or an ounce and a half weighed out and treated with three or four times its volume of spirit. The liquid was separated by pres-

sure, through flannel, and the solid residue was several times washed with spirit, so as thoroughly to remove all that was soluble. By evaporation, an extract of small bulk was obtained, in which the quantity of sugar was estimated with the Barreswil solution, according to the process of Bernard—a process which admits of the greatest accuracy. The subjoined results may be taken as affording a representation of the condition that I can confidently speak of as natural to the right-ventricular blood of life; each specimen having been tested ordinarily with the Barreswil solution, and having behaved in precisely the same manner as those belonging to all the observations I have made. In an excellent-conditioned dog, which had been fed upon tripe six hours previous to the removal of the blood, the quantity of sugar indicated was forty-seven-thousandths of a grain per cent. In another dog, which had not been fed since the previous day, the amount was seventy-three-thousandths per cent. And, in a third, which had been kept for some days past on double the usual allowance of animal food, and which had been fed four hours and a half previous to the abstraction of the blood, the amount indicated was fifty-eight-thousandths of a grain per cent.

With this knowledge before us, it is not difficult by other means to expose the fallacy of an inference drawn from an examination made even almost immediately after death. If an animal be pithed, and a minute or two be allowed to elapse before the chest is opened, the blood flowing from an incision into the right side of the heart will be found strongly saccharine; whereas, if the chest be *instantly* opened after the pithing is effected, and a ligature placed around the base of the heart, the contents of the right ventricle will be noticed as free from sugar as if catheterism during life had been performed. On afterwards, however, excising the heart, and collecting the blood that escapes into the thorax, the same saccharine condition will be observed that we have been hitherto accustomed to look upon as natural to right-ventricular blood of the living animal.

Notwithstanding the discovery of this phenomenon, I thought still that the liver was naturally charged with sugar during life. I had no reason yet to doubt its being endowed with a special sugar-forming function. The next step was,

however, to determine the cause of the difference that had been observed in the constitution of the blood before and after death. Observation up to this period tended to show that sugar was naturally contained in the hepatic tissue, and I therefore began to look to those conditions of the circulatory system, which might favour or prevent the escape of the saccharine principle from the organ. I performed experiments upon the injection of defibrinated bullock's blood through the liver at different degrees of pressure immediately after death. But, arriving at nothing satisfactory, it occurred to me as possible that the liver, like the blood issuing from it, might be free or almost completely free from sugar during life. I did not at first look upon such a supposition as bearing any degree of probability; indeed, so thoroughly was I still labouring under the conviction of the liver being endowed with a glucogenic function, that I considered the notion of trying to ascertain if it were free from sugar during life, as rather an absurd one than otherwise. Nevertheless, I determined to see if I could not effect an examination of the organ, as it were, nearer to life, than had hitherto been done, by suddenly placing it in a condition to arrest any change that might lead to the production of sugar in the act of or subsequent to death. The recent researches of Bernard had shewn me that a material existed in the liver which was most readily convertible into sugar, especially at the elevated temperature of the body during life. And, I sought to discover if means could not be found to check such transformation without the destruction of the principles concerned. Thinking that blood might act as a more energetic ferment with this sugar-forming substance than the tissue of the liver alone, I first injected as instantaneously as possible after death, a solution of sulphate of soda through the vessels, to drive out their contents. An examination of the liver of a rabbit and of a dog thus treated, led me now to entertain grave doubts as to the accuracy of Bernard's glucogenic theory. Only a sufficient quantity of the solution was used to displace the blood from the vessels. The liver structure was not entirely free from sugar, but yielded a very much smaller reaction than I had hitherto been accustomed to observe. On placing it aside, however, for a couple of hours, the amount of sugar had increased so as to

give an abundant orange-coloured precipitate with the Barreswil solution. From further observation, it would appear, that all that was effected in these experiments was to render the *post-mortem* formation of sugar less rapid than usual, by the reduction of temperature that ensued on the performance of the injection.

Upon directing my attention to the properties of the sugar-forming substance apart from the liver, I found that alkalies interfered with its transformation into sugar, whilst in contact with a ferment. Saliva, for instance, almost instantly converts a neutral solution of the liver-substance into sugar, at a moderately elevated temperature; but if a little alkali or acid be added, the change is retarded or prevented according to the amount that is used. I now determined to try the effect of a strong solution of potash injected into the liver as instantaneously as practicable after death. I selected a healthy dog for the purpose, and it was in vain I sought for the presence of sugar either in the liver or the contents of the circulatory system.

The error under which physiologists had been recently labouring was now with full force exposed to demonstration. What has been regarded as the result of a functional operation of life would seem to be nothing more than a *post-mortem* chemical transformation taking place so instantly after life is destroyed as to have hitherto led us into a misconception upon the subject. Before, however, the experiment I have mentioned could be accepted as sufficiently demonstrative to produce such a change in our views, two important questions remained to be decided. The liver operated on might not have been in a natural condition, or the operation to which it was submitted might have destroyed or concealed from our observation sugar that was present at the moment of death. These points are most conclusively cleared up by the following additional evidence. By injecting only half the liver instead of the whole, a portion is left under ordinary circumstances, and will give the strong reaction of sugar that has been until now considered as belonging to life. And, by allowing the organ to remain a few minutes after death before the injection is practised, so as to give time for the *post-mortem* transformation of liver material into sugar to take place, the presence of

sugar is as easily shown as if the potash had not been made use of. The following are the details of an experiment which I some time since performed in the presence of Mr. Hilton, Dr. G. Owen Rees, and Dr. Gull. Dr. Addison was not present at the operative part of it, but witnessed an analysis of the specimens obtained on the following day, when the results were equally as striking as immediately after the experiment.

Experiment.—A healthy dog, which had been for some time past kept under my own observation upon tripe, but which was not fed the day of the experiment. Life was suddenly destroyed by pithing the *medulla oblongata.* The abdomen was instantly opened by free longitudinal and transverse incisions, and 300 grains of potash in three ounces of water injected through the portal vein towards the liver. The injection was allowed to penetrate only a portion of the liver, a part of it having been firmly held by an assistant to secure it from contact with the alkali. The syringe being removed, and the portal vein ligatured, the non-injected portion was separated from the other before the grasp of the assistant was loosened. The injected part, which was rendered pale and soft, was treated in the following manner to test for sugar. A piece being placed in a mortar was triturated to a pulp. A sufficient quantity of strong sulphuric acid was cautiously added to neutralise the alkali, and leave a slight acid reaction; by which a solid mass was procured that yielded a clearish fluid on squeezing in a piece of flannel. This fluid was collected and rendered alkaline with potash so as to enable me to apply the copper-test. It was found that boiling with the Barreswil solution produced no precipitate of suboxide of copper. The non-injected part treated with the sulphate of soda according to Bernard's method, gave a most abundant reduction with the copper solution. But in order to render the experiment complete, and show that the treatment to which the injected portion of the liver was submitted had not destroyed the sugar, a piece of that which had not been injected was now pounded in a mortar with a sufficient quantity of a strong solution of potash to thoroughly saturate it, and allowed thus to remain for about five minutes. It was then treated in the same manner as the injected portion;

and on boiling with the Barreswil solution, gave as strong a reaction as that which had been simply heated with the sulphate of soda. After the injection had been effected, the chest was opened and the contents of the right ventricle removed. The blood presented, as I have always in other instances observed, a perfectly natural appearance, for the capillaries of the liver appear to give way instead of allowing the solution of potash to pass. On examining the blood according to the usual process, the colour of the Barreswil solution remained unchanged under the influence of even prolonged ebullition.

In performing the above experiment everything depends upon the rapidity with which the injection is effected after the life of the animal has been destroyed. The transformation of the liver material into sugar takes place so speedily after death, that unless the greatest promptitude is exercised an unsuccessful result is obtained. In making the injection, I never stop to tie the portal vein around the nozzle of the syringe, but hold it firmly between the thumb and finger instead. When the injection has been made there is no longer occasion for haste. I have known an injected specimen of liver remain for some days without becoming saccharine. With a number of experiments it necessarily happens that some are more happily made than others. Although, in the one I have described, there was no appreciable change to be observed on boiling the liquid obtained from the injected liver with the Barreswil solution, yet it has occasionally happened that a certain amount of change has been observable. In one example, where a slight indication of sugar was afforded, I took a piece of the liver, weighing 385 grains, and carefully submitted it to a quantitative analysis. The amount of sugar I found was seventeen-hundredths of a grain per cent. In other example, where a circumstance occurred which considerably retarded the injection, I obtained a specimen which yielded a strongish reaction of sugar. An analysis was made of the injected and non-injected portions of the liver. The former contained thirty-six-hundredths of a grain, and the latter two grains and seventy-one hundredths per cent.

Although I believe reliance may be placed upon the indica-

tions afforded by the Barreswil solution, yet, in a matter of such importance, it might not be considered sufficient to rest upon its evidence alone. I have, therefore, submitted the product of the experiment to the test of fermentation, and with the most perfect corroboration of the result that had been previously obtained.

My first experiments were conducted with the employment of potash, as I have stated above. But having since found that citric acid will equally answer the purpose, this is the agent I now prefer using, as it does not act so unpleasantly on the hands. Three hundred grains dissolved in three ounces of water is what I employ for injecting into about half the liver. In extracting a liquid for testing, all that is required is to heat with a little sulphate of soda, filter, and neutralise. A fluid is procured to which the Barreswil solution can be applied.

It is not only by injection that the *post-mortem* production of sugar can be arrested, and the condition of the liver that is natural to life be displayed. Knowing how much changes partaking of the character of fermentation are promoted by an elevated temperature, and checked by cold, it might, upon *à priori* grounds, be expected that the influence of a freezing mixture on a piece of liver removed as instantly as possible after death, would be to confirm the deductions drawn from the experiments that have been described. The application of cold has this advantage, that it is much more simple in its effects, and cannot be presumed to do more than prevent those changes taking place which have hitherto misled us to such an extent. There are several bearings under which the influence of cold may be examined, and under all we meet with the most corroborative results.

If an animal, as a dog, be suddenly killed by the destruction of the *medulla oblongata*, and the abdomen be instantly opened, and a piece of the liver cut off and plunged into a mixture of ice and salt, the *post-mortem* transformation of the liver material will be prevented, and an absence of sugar will be observed. On account, however, of the extreme facility with which sugar is formed after death, there are certain precautions to be kept in view to perform the experiments successfully. The ice and salt should be mixed for

half an hour before being used, because when liquefied, the temperature is much lower; and the liver is cooled more rapidly when plunged into a liquid than into a solid mass. The action of cold is only immediate upon the surface, and proceeds gradually inwards, the centre of the piece of liver remaining, after some minutes immersion, soft and dark-coloured, whilst the exterior has become pale, and so hard as to be difficult to cut with a knife. Under the influence of injection all the liver structure is acted upon at the same time; but on account of the effects of cold only gradually proceeding inwards the central parts retain, for a while, a sufficient degree of temperature to lead to the production of a certain amount of sugar. Hence, whilst slices from the exterior of a frozen piece of liver give no reaction with the Barreswil solution, slices through the centre give a recognizable indication, more or less marked according to the thickness of the mass and the coldness of the mixture into which it is plunged. In one experiment, a healthy dog, which had been for some time past kept upon an animal diet, and had been fed at half-past ten in the morning, was suddenly sacrificed by pithing at 4 p.m. The abdomen was instantly opened, and a piece of the liver cut off and thrown into the freezing mixture. The other portion of the liver, after remaining in the animal some minutes, was removed, and submitted to a quantitative analysis. The amount of sugar indicated was 2·96 per cent. The frozen liver was also submitted to analysis. Sections through the centre, which remained still soft, contained within a fraction of half a grain per cent. of sugar. The edges and moderately thick outside parings were treated so as to yield a highly concentrated spirituous extract. In this the saccharine impregnation was so inappreciable as to be unsusceptible of a quantitative determination, notwithstanding the process admits of such delicacy that I have readily effected an estimation in a specimen of blood indicating only the forty-seven-thousandths of a grain of sugar per cent. I could not positively say the liver was entirely free from all traces of sugar; for, although the colour of the blue liquid did not undergo the slightest appreciable alteration beyond the effects of dilution, yet, on placing the mixture of solution and extract aside, after boiling till the following day, a few particles of

red oxide had subsided—just enough distinctly to recognise when thus collected together.

In extracting a liquid from the frozen liver for the purpose of applying the tests for sugar, it is important to avoid those processes which might allow a transformation of the liver material to take place. Heating, with the sulphate of soda cannot be looked upon as otherwise than decidedly objectionable, because it is impossible to raise, with the requisite rapidity, the temperature of the whole mass beyond the degree which is favorable for the production of sugar. The liver may be cut into thin slices, pounded in a mortar, and thoroughly incorporated with spirit. The liver material being insoluble in this agent is left behind, whilst sugar is extracted if present. The usual process, however, that I adopt, is to cut the frozen liver into pieces, and well triturate it in a mortar with a little solid potash, which, like the injection, instantly arrests any formation of sugar taking place. I prefer solid potash to its solution, because it is more easily incorporated with the whole mass of liver, and less likely to leave any part unattacked. The extraction of a liquid is then effected by the addition of sulphuric acid in the manner I have before pointed out.

The only just inference I can see to be drawn from these experiments is, that the liver does not enjoy the special fuctional import that has in recent times been bestowed upon it by physiologists. Such a statement is not incompatible with the result of all our previous experiments. To find sugar on examining a liver after death, is no proof that it was also present during life, and all the evidence upon which the glucogenic theory was founded rested upon ordinary *post-mortem* investigations. The results I have detailed are so striking, and so easily obtained, that I venture to believe it will not be long before our new position will become generally acknowledged. I have recently performed my experiments, first before Dr. Sharpey, and afterwards before Dr. Carpenter; and I think it will be admitted by those gentlemen, with the most convincing results. I submitted one portion of the liver of a dog instantly after pithing, to the action of a freezing mixture, and another to injection with citric acid; a third being allowed to remain under ordinary conditions. The contrast between

the latter and the two former was in the highest degree satisfactory.

Some interesting experiments have been made by Bernard, and are mentioned in the nineteenth and twentieth leçons of his 'Physiologie Experimentale,' Paris, 1855, which show that division of the spinal marrow influences the condition of the liver in relation to the point now under consideration. Had these experiments have been looked upon in what I conceive to be their proper light, it would not have been left for me to announce the discovery which deprives the liver of a sugar-forming function. As Bernard has stated, if the spinal cord of an animal be divided just below the origin of the phrenics, and life be destroyed a few hours afterwards, the liver is free from sugar when examined immediately, but becomes strongly saccharine a little later. The several suggestions thrown out by Bernard, in his 'Physiologie Experimentale,' to account for this phenomenon, show the difficulty he was under to give a satisfactory explanation of it. According to the most plausible, it was considered, that from the depression of animal temperature which attended the operation, the glucogenic function of the liver was arrested :—that the sugar naturally contained in the liver had disappeared, and the temperature to which the organ was now reduced proved insufficient to determine the series of changes which gave rise to the production of sugar. More recently ('Comptes rendus de l'Academies des Sciences,' séance du 23 Mars, 1857) Bernard has referred this phenomenon to an alteration in the activity of the abdominal circulation, saying, "Quand on coupe ou qu'on blesse la moelle épinière dans la region du cou, au-dessous de l'origine des nerfs phréniques on diminue considerablement l'activité de la circulation hépatique on point qu' après quatre ou cinq heures, il n'y a plus de traces de sucre dans le foie de l'animal, dont le tissu reste cependant encore chargé de matière glyco-gène." From what has preceded, the explanation is rendered intelligible enough; indeed, the phenomenon may be brought forward in support of the conclusions I have been advancing. It is not, that any glucogenic function of the liver is arrested; but, that the liver, being normally free from sugar during life, this condition is discoverable under the ordinary process of examination imme-

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diately after death, because the temperature of the animal has been reduced to a degree which renders the *post-mortem* transformation of liver material into sugar gradual instead of rapid. When an animal is ordinarily killed, the temperature of its body is such as to determine so immediate a production of sugar as to have hitherto eluded our vigilance, and led us to regard the result of a *post-mortem* metamorphosis as the representation of an *ante-mortem* condition. When, on the other hand, the temperature of the body is reduced to about 70° or 80° of Fahrenheit previous to death, then the production of sugar is sufficiently slow to enable us easily to alight upon the liver in its natural state.

In repeating Bernard's experiment, I selected a full-grown well-conditioned rabbit. The spinal cord was divided at the lower part of the cervical region by flexing forwards the neck, and inserting a small rather pointed double-edged instrument, between the last cervical and first dorsal vertebræ. Complete paraplegic paralysis and anæsthesia were produced. The animal was laid on the slate floor of an apartment, in which the thermometer stood at 43° of Fahrenheit. Its breathing was exceedingly quick, and entirely diaphragmatic. In three hours and a half it seemed to be dying. The temperature of its rectum was only 67°. Life was destroyed by a violent blow on the head, and the abdomen being opened, the liver was removed, and a portion of it tested with the Barreswil solution after treatment with potash, &c., in the manner I have before pointed out. There was no indication of the presence of sugar. The remainder of the liver was placed near a fire, and exposed for an hour to a temperature of about 100°. A portion of it was then treated precisely in the same manner as the other, and yielded a most copious precipitate of orange-coloured suboxide. The heart continued beating quite half an hour after death. It seemed like of a cold-blooded animal. The blood also remained a corresponding period before it showed the least signs of coagulating.

To determine if the aspect under which I regarded this experiment were a correct one, I performed another, which conclusively shows that division of the spinal cord does not act immediately on the liver, but indirectly through the

reduction of the temperature, causes the phenomenon that has been observed. A rabbit, after having its spinal cord divided in precisely the same manner as the above, was placed over an engine boiler where the thermometer stood at 88°, instead of being laid on a cold slate floor. At the end of three hours it was thoroughly alive, but panted very much, as it had done all along, from the effects of the exposure to such a warm atmosphere. The temperature of the rectum was 104°. The animal was now suddenly killed by a blow on the head, and the abdomen being opened, a piece of the liver was immediately taken and treated as in the former experiment. The indication of sugar was as strong as if the specimen had been derived from an animal which had been suddenly sacrificed without having been submitted to any previous operation. The blood also underwent its ordinary coagulation, and the heart very soon lost its irritability after death.

Further, it is not only by division of the spinal cord, as in Bernard's experiment, that the condition of liver just mentioned is met with. All that is absolutely requisite is, that the temperature, before death, should be reduced to about 70° or 80°. By oiling the coats of animals they are deprived of their non-conducting investment, and their temperature rapidly falls, if exposed to cold. In a summer or moderate atmosphere a rabbit will outlive the operation; but, when the weather is cold, death is occasioned in a shorter or longer period, according to the degree of rapidity at which the radiation of heat is effected. Placed in a strong current of air, a fatal result is most speedily produced. When the temperature of the body has fallen to about 65°, life becomes thoroughly extinguished. I have several times experimented in this way upon rabbits and kittens, and when the atmosphere has not been of itself sufficiently cold for the purpose, I have placed my subject at the bottom of a ventilating shaft belonging to the hospital, in a situation where the air, which has descended from the outside of the top of the building, moves with intense velocity. From my experiments, I have found, that if the animal be killed when the temperature has descended to about 70° or 80°, the liver is

found free from sugar immediately subsequent to death, and and becomes strongly saccharine hereafter, precisely as in the case of section of the *medulla spinalis,* just below the phrenics.

With cold-blooded animals the temperature of the body may be easily made to pass through a wide range of variation without a disturbance of the functions of life. They form most convenient subjects for experiment under the point of view before us. And, here again, the results that have been obtained by Bernard, which coincide with those independently obtained by myself, to the fullest extent corroborate the statements I have made regarding the liver. Before I discovered the facts I am describing, I entertained an idea, from some observations on the blood after death, that the activity of the glucogenic function varied according to the temperature to which the animal was exposed. In March, 1857, I conducted an experiment upon some frogs. The weather was cold, but not frosty at the time. I took six, and exposed three for a couple of hours to an atmosphere at a temperature of 90°, whilst the others were allowed to remain ordinarily in the air. At the end of the two hours the frogs were killed, and their livers examined. The livers of the three that had not been exposed to heat were treated together, and tested for sugar, but gave no reaction with the Barreswil solution. The livers of the other three were similarly treated, and gave a decided indication of the presence of sugar. In other experiments this observation was confirmed. I was one day, however, much astonished and puzzled at a result I accidentally obtained. I had exposed half a dozen frogs for three hours and a half to an elevated temperature—to an atmosphere, in fact, of about 98°. They were removed from this temperature, and casually placed aside in my laboratory for a quarter of an hour before an examination was made. Being then killed, the livers of three were taken, and together treated and tested for sugar, of which principle, however, there was no indication, or, at the outside, the merest trace of one. The other three having been kept (in a dead state) till the following day, the livers, on examination, gave a marked reaction with the Barreswil solution. The idea I possessed at the time these experiments were being conducted was, that an

elevated temperature increased the activity of the glucogenic function of the liver—that, by the exposure to which my frogs were submitted, they were thrown, so to speak, into a diabetic condition. With this supposition, however, it was difficult to reconcile the result just mentioned; for I could not conceive it probable, presuming the state I imagined had been induced by the three hours and a half exposure to an atmosphere of 98°, that the sugar could disappear during the short period in which the animals had been left at an ordinary temperature before they were killed. The fact, that sugar was found in the livers of the three that were set aside till the following day, was an important one, as it showed that the liver structure was not devoid of the sugar-forming substance. This is a point, indeed, that must always be looked to in experiments of this kind on frogs. When these animals are brought fresh from the country their livers are large, of a palish fawn-colour, and with bile of a light sea-green. In this state the organ is rich in the sugar-forming substance, and therefore suitable for our purpose. When, on the other hand, these animals are confined in a laboratory, and kept for a time without food, the liver becomes small and dark-coloured, and the bile of so deep a green as to approach to black. Such is especially the case during the warm weather of summer. The organ, then, has lost the material requisite for the *post-mortem* production of sugar, and will be not only without sugar immediately after death, but continue in the same state afterwards.

It is right to mention, that in the above observations on the influence of temperature in determining the presence or absence of sugar in the liver of frogs, I was anticipated by Bernard. Just at the time my experiments were being conducted, Bernard communicated his to the Parisian Academy of Sciences. Instead of its being a matter of regret to me, however, to be obliged to give up the claim to priority, it is a matter of satisfaction, inasmuch as the fact acquires such additional stability from its independent observation by another. I will extract from the 'Comptes Rendus,' of the Academy of Sciences for March 23d, 1857, the passage which mentions the results obtained by Bernard, and, at the same time, expresses his views regarding them: "Chez les animaux hibernants,

ou engourdis, comme les grenouilles par example, le ralentissement de la circulation, qui est lié à l'abaissement de la température amène une diminution et quelque fois une disparition à peu près complète du sucre dans le foie. Mais la matière glycogène y est toujours, ainsi qu'on le prouve en l'extrayant. Il suffit alors de mettre les grenouilles engourdis à la chaleur pour activer leur circulation et voir bientôt le sucre apparaître dans leur foie. En plaçant de nouveau les animaux dans une basse température, on voit le sucre diminuer ou disparaître pour se montrer de nouveau quand on remet les grenouilles dans un milieu où la température est plus élevée. J'ajoute qu'on peut reproduire plusieurs fois ces singulières alternatives d'aparition et de disparition du sucre sans que l'animal prenne aucun aliment et en agissant seulement sur les phénomènes de la circulation par l'intermédiare de la température."

My own explanation of this phenomenon may be easily premised from what has preceded in this communication. The observation, in fact, strongly supports the conclusions I have otherwise arrived at. It cannot now, I conceive, be admitted with Bernard, that the result is dependent on the relative activity of the circulation previous to death. We are compelled, I think, to leave the question of a glucogenic function out of sight, and to state that the phenomenon is due to the relative activity of the production of sugar after death. When the animal is killed at an elevated temperature the *post-mortem* transformation of liver material into sugar takes place—as in the warm-blooded animal—so rapidly, that sugar is found under the ordinary process of examination. When, on the other hand, the animal possesses a low degree of temperature at the period of death, the *post-mortem* formation of sugar is so retarded that we are enabled easily to effect our examination of the liver before a change has taken place to any appreciable extent.

From a consideration of all the facts brought forward, which, in every respect, to the fullest extent corroborate each other, and which stand uncontroverted by any single result I have yet encountered, I think we are unavoidably led to deprive the liver of that sugar-forming function with which, in recent days, it has been endowed by physiologists. Our posi-

tion in reality stands thus. The conclusions upon which our former notions were based, were drawn from the results obtainable after death. But, it now becomes apparent that we are no longer justified in regarding these results as indicating the condition that belongs actually to life. It is not that Bernard's observations are incorrectly recorded, or his experiments inexact; but that fallacious inferences, as shown by more extended investigation, have been drawn from these experiments and their results. The views I have advanced are in every respect perfectly compatible, not with our former conclusions it is true, but with the experiments upon which those conclusions were founded. From an ordinary examination of the liver and the blood of the right side of the heart after death, we obtain reactions that infallibly indicate a large impregnation of sugar. The deduction from this hitherto has been, that the sugar existed there naturally during life. This deduction, however, although it has appeared to our minds exceedingly plausible—so plausible, indeed, that no one before has been led to question it; yet, confined to such experiments, it is obviously gratuitous. All that can be strictly or logically inferred from such examination is, that the liver and the right-ventricular blood are strongly saccharine *after death;* to show that this is likewise the condition *during life* requires another mode of experimenting. And notwithstanding, as it is fair to confess, nothing was to have been reasonably expected beyond a ratification of our views; yet, on actually prosecuting the inquiry, it turns out that we can no longer overstep the strict letter of interpretation belonging to the original experiments.

A special attribute of the liver would appear to be, to form a substance which happens to be with extreme facility, by a process allied to fermentation, convertible into sugar. Considerations concerning the nature and the production of this substance under different kinds of diet, will be found in another communication. Suffice it to say, that the material in question appears to be always present to a considerable extent in the healthy state. It seems to have the power to resist, whilst located in the tissue of the living and healthy liver, transformation into sugar. With the destruction of life this power of resistance is at an end, and the organ then be-

comes speedily charged with the saccharine principle. Under natural circumstances the blood circulates through the liver, and escapes charged with but an infinitesimal amount of sugar: whilst, under certain unnatural states, the quantity of sugar becomes greatly increased. But, sugar being met with in the blood, does not necessarily arise from the exercise of a glucogenic function of the liver. The substance formed by this organ has only to pass into the blood-vessels to give rise to a saccharine condition of their contents; for, immediately it mixes with the blood it becomes transformed into sugar—a statement that may be easily verified by injecting it into the jugular vein of a living animal. I have repeatedly performed this operation on the rabbit and the dog. It rapidly gives rise to a strongly-marked diabetic condition of the urine. A little escape of the material belonging to the hepatic tissue into the blood whilst circulating through the liver, would rationally account for the trace of sugar spoken of as encountered in the circulation under ordinary circumstances. Such a view is not only in harmony with what has been shown to be the actual condition of the liver during life, but is strongly supported by what is observed as the result of disturbances of the circulation.

In my communication to the Royal Society, I have given the particulars of experiments which show, that under violent struggling, or an interruption of the respiration, sugar makes its appearance to a considerable extent in the circulatory system. If blood be removed from the carotid artery immediately on exposing the vessel, it is ordinarily found, in a marked degree, more saccharine than if removed five or ten minutes after the operation has been effected. Now, in exposing the carotid artery, on account of its contiguity to the pneumogastric nerve, considerable struggling and disturbance of the breathing is ordinarily produced, and in this way the liver is submitted to compression, and its vessels to congestion. That obstruction of the respiration determines the production of sugar in the system is most easy of demonstration. In one experiment I removed some blood by catheterism from the right ventricle of a dog. The animal's nose was then muffled, so as to render breathing difficult, for half an hour, and thus occasion partial asphyxia. A second portion of blood

was withdrawn from the right ventricle. An analysis of the two specimens indicated only seventy-nine thousandths of a grain of sugar per cent. in the first, and twenty-nine hundredths per cent. in the second. These results will, I think, be admitted to accord with what we should expect under the view that has been taken. Compression of the liver, as in violent struggling, will naturally tend to occasion an escape of the contents of the hepatic cells into the circulation. Again, during obstruction of the breathing, the right side of the heart becomes gorged with blood, and the whole venous system congested. By the retardation in the flow of blood, and the distension to which the liver is submitted, there is, I apprehend, produced an undue admixture between the contents of the liver-cells and blood-vessels. A transudation of liver material into the blood will immediately occasion the presence of sugar.

Depletion of the circulatory system also gives rise to the same result as the opposite state of which I have just spoken. It has been shown by Bernard, and I have noticed it myself, that if an animal be bled to death, notwithstanding the first portion of blood that escapes contains scarcely a trace of sugar, the last is pretty strongly impregnated with this principle. The explanation appears to me to be this. The removal of blood occasions a diminished tension of the vascular system, which favours the absorption of the fluids saturating or belonging to the tissues. There is, so to speak, a kind of drainage from the tissues of the body into the circulatory system, and with this drainage in the case of the liver, the special material found in this organ passes into the blood, and being immediately transformed into sugar, accounts for the phenomenon observed.

The precise condition in diabetes, it must be admitted, still remains almost as obscure as ever. I have always thought that nothing much was likely to arise from investigations into the pathology of this disease until the physiology of the subject was placed upon a thoroughly substantial foundation. From what has been now disclosed, I venture to hope a considerable advance has been made, and that, with a few steps more, we may arrive at something definite regarding the nature of diabetes. I do not, in fact, despair of one day seeing our present obscurity cleared up.

The artificial diabetes produced by puncturing the floor of the fourth ventricle has been considered by Bernard to result from an excitement of the hepatic circulation. My own recent experience does not enable me to confirm this opinion. I consider, at present, on reviewing the whole of the facts before me, that in the artificial and idiopathic diabetes, from some defect in the functional performance of the processes of the liver, the substance naturally produced by it is incapable of resisting transformation into sugar, as it does under normal circumstances.

The influence the nervous system possesses in relation to this matter has yet to be determined; but the state of the liver in diabetes seems strictly to accord with that which is noticed when life has been destroyed. It has been sufficiently shown that a metamorphosis takes place immediately after death, which gives rise to the presence of sugar in the liver. Now, if an animal be killed by pithing, and the circulation be maintained by artificial respiration, the sugar produced in the liver is distributed throughout the system, and eliminated by the kidneys, so that in the course of an hour, or even less, the urine becomes exceedingly saccharine, apparently as much so indeed as after the operation of puncturing the floor of the fourth ventricle. I may observe, that this same occurrence has been noticed by Bernard, after destroying the functions of the brain by a violent blow on the head, and also after the exhibition of the woorali poison. If what I have been induced to surmise should ultimately prove to be the natural destination of the material which is transformed into sugar after death and in diabetes, the waste of adipose tissue which forms so prominent a feature of this disease receives an intelligible interpretation. But I hope to be enabled to say something further on the subject of diabetes hereafter.

THE

INFLUENCE OF DIET ON THE LIVER.

By F. W. PAVY, M.D., Lond.

We are indebted to the researches of Bernard for the discovery of the substance in the liver which gives rise to the production of the sugar that we find in the organ after death. He first noticed, that if the liver were completely deprived of the sugar it contained a short time after death, by passing a stream of water through its vessels, it was again found saccharine some hours afterwards. It was this observation that paved the way towards the discovery of the sugar-forming substance; for it was evident that something existed in the liver from which sugar was susceptible of formation. The next step was to endeavour to obtain this substance in an isolated state, and then to study its relations. Without any other information than that supplied by Bernard's first observation, I had myself separated the sugar-forming substance from the liver, and had noticed the influence of several chemical reagents on its transformation into sugar. I lay no claim, however, for a moment, to the credit of discovering this substance; for, whilst my own knowledge was in an exceedingly imperfect state regarding it, Bernard had procured it, and described its more important properties, in his communications to the Académie des Sciences de Paris of March 23d and June 29th, 1857.

According to the opinion of Bernard, this substance is formed and afterwards transformed into sugar during life. He hence has termed it the glucogenic matter of the liver. This name is doubtless exceedingly appropriate after death

has taken place, and in certain unnatural states of the system. But, if sugar be not normally formed during life, as has been hitherto believed, the term glucogenic necessarily conveys an erroneous impression to our minds, when looked upon in a physiological point of view. We are giving a name, in fact, to a substance which implies a purpose to which the facts contained in my other communication show it does not naturally administer in the living animal, or at least to a scarcely notable extent. From what I shall presently bring forward, sugar will be shown in reality to constitute a natural and most productive source of this material—a fact which, even taken alone, would induce us to look with suspicion upon the correctness (physiologically speaking) of the term glucogenic, as applied to the body in question. Much as it may be desired to avoid the introduction of fresh names, yet I think, in this particular case, the new facts before us necessitate a change. Were I only to consult my own inclinations, I would suggest the term Bernardine for this substance, in deference to its discoverer. I fear, however, lest in adopting such a course, I might be departing too much from custom—lest such a term might be open to the objection that (as far as I am aware) no other body of a physiological nature is named upon a similar principle. I therefore propose to call it hepatine—a term which, whatever may ultimately prove to be the purpose of the substance during life, cannot convey an erroneous impression; and which, nevertheless, is strictly pertinent. What, then, I have referred to in my other communication as liver material, or—in speaking of it after death—as sugar-forming substance, will be understood to constitute that which I shall designate hepatine in the remarks I have now to make.

This hepatine, which forms an abundant production of the liver, appears, from the application of chemical agents, combined with the use of the microscope, to be located in the hepatic cells. It is only present in a normal or healthy state; so that its formation alone may be regarded as resulting from the exercise of a specific functional activity of the organ. Being soluble in water, insoluble in alcohol, and remaining unaffected on boiling with potash, constitute properties by which it is easily separated from other materials. I will first mention the method I adopt for its extraction, and for estimating its

amount in the liver, and will then refer to the influence of diet on its production.

The most economical and easy method I know of for procuring hepatine from the liver in a tolerable state of purity, is according to the following process. The liver of a recently killed animal is submitted to a stream of water passed through its vessels to wash away the sugar, and then cut into small pieces and thrown into a sufficient quantity of boiling water to cover it. After half an hour's boiling, the liquid is strained off through flannel, and the solid residue pounded in a mortar, and then boiled again for an hour or so, with a fresh and larger quantity of water, to dissolve out as much as possible of the hepatine. The liquid is now again strained off, and all that can be obtained by the use of pressure is collected. The liquids are then mixed together, and placed in an evaporating dish over a flame or fire. A scum soon begins to collect on the surface, which consists of hepatine. This is to be removed with a spatula or glass rod, and placed in a saucer or any other convenient receptacle, to drain. As the liquid becomes more concentrated the scum forms with greater rapidity, and layer after layer having been successively removed, the quantity of liquid is exhausted until only a small bulk is left, which should be thrown away. The decoction of liver not only contains hepatine, but also various impurities. It follows, therefore, that the more concentrated the liquid becomes, the more exposed is the hepatine, which is removed as a scum, to contamination. The hepatine thus collected is heaped up into a mass and drained of as much fluid as possible. It is now of a soft, pulpy, or glutinous consistence, a sticky nature, and of a somewhat pale-yellowish colour. Spread out, and allowed to dry spontaneously, it forms a semitransparent, hard, brittle, gum-like resinous looking body. From its mode of preparation it of course is not perfectly pure; but still is sufficiently so to enable us to study its relations; and, indeed, for all purposes except the determination of its constitution. The most important point to be attended to is, that it should be devoid of saccharine impregnation.

When a state of actual purity is required, the liver is boiled with a solution of potash, in which the whole disappears, and is dissolved. The hepatine is precipitated by alcohol, and after

repeated washings, re-solution, re-boiling with potash, re-precipitation, and neutralization of the alkali, to which it clings with great tenacity, with acetic acid, it may be regarded in as pure a condition as it is possible to procure it.

Founded on this process of preparation, is the method I adopt for determining the amount of hepatine in different specimens of liver; and, as it is by this method that the results to be mentioned have been obtained, I will enter into details regarding it. A piece of liver, weighing about 200 grains, is taken and reduced to a pulp in a mortar. About two thirds of its weight of caustic potash being added, the two are incorporated together, and then transferred to a small porcelaine capsule. The pestle-and-mortar are thoroughly rinsed with a little distilled water, and these rinsings being poured into the capsule, furnish a liquid for solution to be effected. By means of a strongish heat, boiling is kept up for about half an hour, at the expiration of which time not a vestige of liver remains, and a limpid, dark-coloured liquid is obtained. After cooling a little, this is poured, with the washings of the capsule, into about five or six times its bulk of spirit—the re-distilled methylated spirit is what I employ—and whatever hepatine is present is instantly thrown down as a white flocculent precipitate. The whole is placed aside for a few hours to allow the precipitate to subside, and the supernatant liquid, which is more or less dark coloured, according to the quantity of sugar that has been present in the liver, being drawn off with a pipette, a fresh quantity of spirit is added, and the precipitate well stirred, so as to remove the impurities that may be adhering to it. After the precipitate has subsided, the liquid is again removed, and the process of washing is performed at least three or four times, in order to extract as much as possible of what is soluble. It is then poured on to a filter, and again washed till the spirit that runs through is perfectly colourless —an operation which, from the form in which the hepatine is thrown down is readily and rapidly accomplished. All that remains, is to thoroughly dry and then determine the amount of the precipitate. The weight of the filter is counterpoised by placing another of the same size in the opposite scale of the balance.

The residue thus obtained consists almost entirely of hepatine joined with a certain amount of potash, to which it clings with such tenacity that even after redissolving in water and precipitation with spirit, it still remains to a small extent contaminated. In the case of the largest precipitate of hepatine that I have yet obtained from a liver, a portion of the residue on the filter was submitted to analysis, to estimate the actual amount of potash it contained. The liver which belonged to a dog that had been fed on a vegetable diet, yielded a thoroughly dried hepatine precipitate amounting to 25·3 per cent.; 5·3 grains of this residue were taken and heated on platinum foil with the blow-pipe flame till nothing but a white incombustible residue remained, which weighed 1·1 grain. This incombustible residue deliquesced on exposure to the air, and effervesced on the addition of nitric acid, so that it doubtless consisted of carbonate of potash. Whether the potash became carbonated in the act of burning, or before, I am unable to say, but presuming it to have existed as such in the precipitate, then nearly one fifth of the 25·3 per cent. residue will have been due to contamination with alkali.

When the process is conducted as I have recommended, then the hepatine instantly falls upon the action of spirit, as a white flaky precipitate, which is easily washed on a filter, and is not impregnated with a sufficient quantity of potash to render it moist on exposure to the air. But should the potash solution of the liver be placed aside, and left for some hours before it is poured into spirit, then the hepatine falls in combination with so much alkali that the character of the precipitate is altered. It is no longer white and flaky, but brownish-coloured, and so minutely divided that it takes a considerable time to subside; and when collected into a mass, it forms a somewhat sticky material, which is most troublesome and difficult to wash. It also has a tendency to adhere to the bottom of the glass vessel; and upon being thrown on a filter, clogs up the pores, and thus renders filtration tedious. It always remains dark-coloured, and when dried and exposed to the air, it soon becomes damp from the attraction of moisture. I have analysed this kind of precipitate, and have found it to contain from one half to a third of its weight of potash. Hence such a mode of procedure, which leads to

the formation of such a precipitate, is especially to be avoided.

Besides this contamination with potash, there is a minute quantity of a dark-coloured matter which also falls with the hepatine. When the liver is boiled with potash, a limpid liquid is obtained, which placed aside, however, for some time, allows a small quantity of an exceedingly fine brownish sediment to subside. Now this brownish sediment also descends when the potash solution is poured into spirit, and constitutes the only deposit where no hepatine is present. It differs from hepatine, not only in colour but likewise in taking an exceedingly long time to fall. When, for instance, a portion of liver devoid of hepatine is treated with potash and poured into spirit, no immediate precipitate is apparent, but the liquid presents a slight opalescence or turbidity, and at the end of some hours a small amount of an exceedingly fine sediment has collected. Hence in performing the analysis, it is most easy to decide whether hepatine be present or not; for, if present, it is instantly thrown down as a flaky precipitate by the action of spirit. When the amount of hepatine is small, the precipitate is slightly tinged with this brown matter, and dries of a fawn colour instead of white. But when the quantity of hepatine is large, the brown matter is in too scanty a proportion to affect its appearance, and it dries of a beautiful white. A separation is easily accomplished by the agency of water, and the hepatine may be afterwards thrown down, nice and white, by the addition of spirit. It seems to me, however, that this further treatment is perfectly unnecessary, for the amount of contamination in this respect is so small that it cannot possibly interfere with the physiological deductions I made through the medium of this process. Indeed, this contamination would rather operate against, than in favour of my conclusions, for its proportion is in a marked degree relatively larger in a scanty than in a copious precipitate. I mean, that where the quantity of hepatine is small, the error will be infinitely greater from the presence of this brown matter than where the quantity is large. In the 25·3 per cent. residue before referred to, 25 grains yielded only 0·5 grain, or one-fiftieth of its weight of this substance, the remainder of the precipitate consisting entirely of hepatine and potash in the proportions as I have stated,

of one fifth of the latter to four fifths of the former. The liver in question, then, furnished merely half a grain per cent. of this contaminating matter, which is perfectly insignificant when compared with the entire per centage of precipitate. Suppose a liver, however, only to yield a precipitate of two or three per cent., then the half a grain per cent. of contaminating matter will produce an infinitely larger relative augmentation of the residue than before. But, further, I have reason to believe the per centage of this brown matter even to be larger where the liver is poor than where it is rich in hepatine.

I will give a few instances shewing the amount of deposit yielded by the analysis, in specimens of liver, where, from a morbid state before death, no hepatine was present. In each of these cases there was no immediate precipitate on pouring the potash solution of the liver into spirit, but at the expiration of some time a minutely divided brown sediment subsided, which was washed, collected, and weighed.

A dog that had been operated on to obtain some pancreatic juice, and that had succumbed on the third day afterwards. The liver contained neither hepatine nor sugar. On boiling with potash and treating with spirit, it gave 0·61 per cent. of a snuff-brown deposit.

A rabbit which had been unsuccessfully punctured to produce artificial diabetes. From the injury to the nervous system, it had been unable to eat, but had lived till the seventh day after the operation. The liver submitted to the treatment under consideration gave 1·00 per cent. of deposit, which consisted to a considerable extent of flaky scales of cholesterine.

Another rabbit which had been punctured at the same time, which had presented a similar train of symptoms, and had even died on the same day. The liver, treated with potash and poured into spirit, yielded 2·07 per cent. of deposit. With regard to this case, I find it remarked in my note book that the sediment was but imperfectly washed from the obstruction it offered to the process of filtration, and that the filter was deeply stained and seemed thickened when dry.

A rabbit which during a few days had become exceedingly ill-conditioned, and which was evidently in a moribund state when sacrificed. The liver furnished 1·95 per cent. of brown-coloured deposit.

I have submitted the spleen, kidney, and white of egg to the action of this process, and find them to behave in a similar way to a specimen of liver where hepatine is absent. Boiled with potash, a limpid liquid is procured, which, on being poured into spirit, does not produce an immediate precipitate, but occasions a slight opalescence or turbidity, and determines at the end of some time the settlement of a small quantity of a somewhat fawn-coloured deposit.

I have entered into these particulars, because I regard it of the utmost importance that we should have before us ample data regarding the nature and the precise value of the numerical indications of a process by which the results in the forthcoming experimental observations have been obtained. Although the whole of the precipitate that falls cannot strictly be accounted as hepatine, yet, bearing in mind that the error from the presence of impurity in one analysis is repeated in another, it is obvious that a fair result is arrived at. It is not the absolutely exact amount of hepatine in a liver that our physiological researches render it necessary to obtain; all that is required is a correct comparative representation of the amount in the different specimens that may be submitted to examination. Again, as will be seen further on, our conclusions are drawn from such strongly marked results, that an error of even a few units per cent. would not in the slightest degree invalidate their substantiality. But, speaking from an experience of upwards of two hundred repetitions of this analysis on different livers, and specimens of the same liver under different circumstances, the extreme uniformity of the figures I have obtained leads me to look with the utmost confidence upon the accuracy, even to a minute extent, of the results that are afforded.

It was during the prosecution of my researches on the subject of sugar that I was led to discover the facts to which I am about to advert, concerning the production of hepatine by the liver—facts, I believe, that will conduce to a considerable advancement of our knowledge in a physiological point of view, and likewise present important bearings in the practice of medicine, by supplying us with more definite principles than we have hitherto possessed regarding the influence of diet on the liver. I have found that the size of this organ is to a

most astonishing extent influenced by the kind of food that is given; and that the alteration it thus undergoes is chiefly, if not entirely, due to the relative amount of hepatine present. I was first conducted to this point by examining if the quantity of sugar in the liver and blood of the dog after death, were modified by the administration of a strictly vegetable diet. The process I then adopted for determining the amount of sugar in the liver, was to remove and weigh the organ, and then pass a stream of water through its vessels, until its tissue was deprived of all the sugar it contained. About eighteen or twenty pints were generally used for this purpose; and after the exact quantities had been measured, a pint was taken and evaporated down to an ounce, in which the amount of sugar present was estimated. Now, in performing this proceeding after a vegetable diet, I noticed: first, that the liver was of a most remarkable size in comparison with what I had been accustomed to meet with under an animal diet; and, secondly, that there was such a quantity of a material present—which on subsequent examination I found to be hepatine—in the liquid after injection through the liver, that when it was in a concentrated state, a determination of the amount of sugar was rendered troublesome to effect. I repeated this experiment, and noticing a similar occurrence, then commenced a series of observations which I think clearly disclose a fact of much physiological importance that has remained till now unnoticed.

From this series of observations, it will appear that the liver of the dog may be in a short space of time doubled in weight by a vegetable diet, and nearly so by an animal diet with which sugar is largely mixed. As a strictly animal feeder, the liver of the dog, from an average of eleven examples, nearly equals half an ounce to every pound the animal weighs. Under a strictly vegetable diet the average proportion given by five examples exceeds an ounce to a pound; whilst upon an animal diet mixed with an allowance of sugar, the figures which result from the four observations I have collected, yield within a fraction the relative proportion of an ounce to every pound. An estimation of the amount of hepatine present was made in most of the examples, and the analyses show to what extent the production of this material is also influenced

by the nature of the diet. The leading features connected with each observation are furnished, and it will be understood that in every instance the animal was sacrificed in a state of health. The observations are given in the order they occurred under the separate heads. And the dogs were taken just as they happened to be brought to me, without any selection, except such as was absolutely needed for the vegetable and saccharine diet—many dogs utterly refusing to partake of this kind of food. Numbers are affixed to the observations, for the sake of facilitating the reference made to them in the remarks that follow. The weights employed were those of the avoirdupois scale. The liver is given without its bile, and the dogs were weighed just before life was destroyed.

The Liver of the Dog under a Diet of Animal Food.

No. 1. A spaniel dog, fat, and in excellent condition. Kept for six days under my own observation on a good sized bundle of tripe daily. Fed at 11·30 a.m., and sacrificed about four hours and a half afterwards. Weight of dog $15\frac{1}{2}$ lbs.; weight of liver $7\frac{3}{4}$ ozs.

No. 2. A smallish rough terrier dog, twelve days under observation on a bundle of tripe a day. Fed at 8 a.m., and sacrificed at noon by the destruction of the medulla oblongata. Weight of dog 12 lbs.; weight of liver $7\frac{1}{4}$ ozs.

No. 3. A mongrel dog, in good condition. A fortnight under observation on a bundle of tripe a day. Fed at 8·30 a.m., and sacrificed at 2·45 p.m. Weight of dog 11 lbs. $14\frac{1}{2}$ ozs.; weight of liver $6\frac{1}{8}$ ozs. Hepatine precipitate 8·29 per cent.

No. 4. An average sized mongrel dog, in good healthy condition. Two days under observation on tripe. Not fed the day it was sacrificed. Weight of dog 15 lbs. 10 ozs.; weight of liver $7\frac{3}{4}$ ozs. Hepatine precipitate 5·24 per cent.

No. 5. A nearly full-grown terrier pup, which was rather thin, but, nevertheless, in a healthy-looking condition. Kept for four days under observation on tripe. Not fed the day life was destroyed. Weight of dog 11 lbs.; weight of liver 6 ozs.

No. 6. A terrier dog, which had been fed for several days on tripe. Not fed the day it was sacrificed. Weight of dog 11 lb. $15\frac{1}{2}$ ozs.; weight of liver $6\frac{1}{2}$ ozs.

No. 7. An ordinary sized terrier dog, rather thin, but extremely lively. Had been kept for ten days on a diet of tripe—during the first six on one bundle, and during the last four on two bundles a day, which it ate with voracity. It was fed at 10 a.m., and sacrificed four hours and a half afterwards. Weight of dog 15 lbs. $5\frac{1}{2}$ ozs.; weight of liver $8\frac{3}{4}$ ozs. Hepatine precipitate 5·61 per cent.

No. 8. A large healthy-conditioned mongrel dog. Had been under observation feeding upon tripe for fourteen days. At first a bundle a day had been given it, but during the last four days it was allowed an unlimited supply, and devoured three bundles the first day, four the second, five the third, and two and a half the fourth. It was sacrificed by pithing five hours after taking the last meal mentioned. Weight of dog 24 lbs. $4\frac{1}{2}$ ozs.; weight of liver $11\frac{3}{4}$ ozs. Hepatine precipitate 8·45 per cent.

No. 9. A spaniel dog, restricted for six days to tripe, one bundle a day. Fed at 10 a.m., and sacrificed five hours afterwards. Weight of dog 14 lbs. $9\frac{1}{2}$ ozs.; weight of liver $7\frac{1}{8}$ ozs. Hepatine precipitate, 4·88 per cent.

No. 10. A dog of the Skye terrier breed. Kept for more than a month on a bundle of tripe a day. Fed at 10·30 a.m., and sacrificed at 4 p.m. Weight of dog 17 lbs.; weight of liver, $8\frac{7}{8}$ ozs. Hepatine precipitate, 10·95 per cent.

No. 11. A three parts grown pup. Kept for six days under observation on tripe; sacrificed five hours after a meal. Weight of dog $9\frac{1}{2}$ lbs.; weight of liver $7\frac{1}{4}$ ozs. Hepatine precipitate, 6·94 per cent.

Table showing the Weight of the Liver in the foregoing Examples on a Diet of Animal Food.

No.		Weight of dog. lbs.	ozs.		Absolute weight of liver. ozs.		Relative weight of liver to animal.
1	...	15	8	...	7¾	...	1-32d
2	...	12	...	...	7¼	...	1-26½th
3	...	11	14½	...	6⅛	...	1-31st
4	...	15	10	...	7¾	...	1-32d
5	...	11	...	...	6⅛	...	1-29th
6	...	11	15½	...	6⅛	...	1-29½th
7	...	15	5½	...	8¾	...	1-28th
8	...	24	4½	...	11¾	...	1-33d
9	...	14	9½	...	7⅛	...	1-32d
10	...	17	...	...	8⅞	...	1-30½th
11	...	9	8	...	7¼	...	1-21st
Total	. . . .	158	11½		85⅛		1-30th

The average of eleven examples, indiscriminately taken, of dogs that had been restricted for some days prior to death to an animal diet, thus gives to the liver a weight equal to the 1-30th part of the animal. On casting the eye through the list, it will be seen that in neither instance is there any very striking departure from this average, except perhaps in No. 11, which consisted of a three parts grown pup. But even here, where the highest proportion I have yet met with is yielded, the weight, as will be shortly apparent, falls very far short of the average, after a vegetable diet, or an animal diet with the addition of sugar.

Under a morbid state of the system, where neither hepatine nor sugar is found in the liver after death, the organ in the only two instances that I have specially examined, presented a still less comparative size. In one, a dog that died on the third day after an operation had been performed, which involved the exposure of the peritoneal cavity, the weight of the animal was 13 lbs., that of the liver 6 ozs. Relative weight of liver to animal 1-35th. In the other, a healthy dog was killed in the course of a few hours by the injection of 200 grains of carbonate of potash in solution into the stomach. The weight of the animal was 17 lbs. 12 ozs., that of the liver 7¼ ozs., which gives to the latter a proportionate weight of 1-39th part of the animal.

Looking now to the amount of hepatine present, I find the analyses I have made to yield the following results. I have before referred to the process I adopt for the determination of this material, and have stated that the hepatine precipitate which is collected is, to a certain extent, contaminated with potash, and to a slight extent with a brownish material, which also falls on pouring the potash solution of the liver into spirit. In addition I may say, that from the rapidity with which hepatine passes into sugar after death, especially if the liver be maintained at an elevated temperature, it is necessary that the examination should be conducted as near as possible under the observance of similar circumstances, to arrive at a fair comparative estimate of the amount of hepatine in different specimens. This point did not formerly strike me with the full force it demands. Hence a few of my analyses in the *foregoing* examples are from this cause rendered objectionable, and are therefore excluded from the subjoined table. In all the *following* results, however, which are brought forward to serve for affording an average, the same conditions have been as near as possible throughout observed. In each case the liver was removed from the animal immediately after death, quickly weighed, and the examination immediately commenced.

Table showing the relative amount of Hepatine in the Liver after an Animal Diet.

In Ex. 3.	The liver	yielded	8·29	per cent.	of hepatine	precipitate.
" " 4.	"	"	5.24		"	"
" " 7.	"	"	5·61		"	"
" " 8.	"	"	8·45		"	"
" " 9.	"	"	4·88		"	"
" " 10.	"	"	10·95		"	"
" " 11.	"	"	6·94		"	"
A dog, not included in the preceding examples, as the weight of the liver could not be determined on account of the injection of a part of it with citric acid. The animal had been kept for several days on tripe, and had been fed at 10 a.m., and sacrificed at 4 p.m. The liver yielded .			5·44		"	"

Average per-centage of hepatine precipitate yielded in the above eight observations 6·97.

In the examples to which the above analyses refer, a variety

is presented as regards the amount of food given, and the time since it had been taken previous to death. But I cannot trace that these circumstances, within the limits noticed, possess any bearing of consideration. In example No. 10, the liver was exceedingly rich for an animal diet, giving upwards of two-and-a-half per cent. more of hepatine precipitate than in the highest of the remaining examples, and four per cent. above the average of the eight. The organ itself was about the average proportionate weight; the dog presented an ordinary condition, and had been fed for a considerable time on a bundle of tripe daily. The only point of note regarding it is, that about a fortnight previous to being sacrificed, lactic acid was to a large extent injected into its system through the jugular vein, from the effects of which, however, it had never manifested the slightest disturbance. In examples Nos. 7 and 8, the animals were specially fed, to determine if an allowance of food beyond the ordinary quantity would occasion an increase in the size of the liver and the amount of hepatine present. The observations show, that it does not to any significant extent. In No. 7, two bundles of tripe daily were given during the last four days before death; the liver was only slightly above the average size, and the per centage of hepatine precipitate yielded was 5·61. In No. 8 the animal was allowed its full tether, and the quantity of tripe devoured was truly enormous; the liver was under the ordinary size, and the amount of hepatine precipitate furnished was 8·45 per cent.

The following results refer to the instances in which the analyses were open to objection, and which were therefore excluded from the preceding list. In example No. 2, the liver was left in the body of the animal for two hours and a half before it was examined. The abdomen, however, had been opened, and the liver exposed to the air. The per centage of hepatine precipitate was 3·37. In No. 5, which was about a full-grown pup, the liver had been left in the animal for ten minutes, and then removed, but not examined for the space of two hours. The per centage of hepatine precipitate was 3·5. In a dog not hitherto mentioned, which had existed for some months with a gastric fistula, and which during the last few weeks had been badly nourished, from the escape of food through the opening, but was otherwise unaffected; the liver

examined immediately after the sudden destruction of life by pithing yielded 3·57 per cent. of hepatine precipitate.

The Liver of the Dog under a Diet of Vegetable Food.

The following are the particulars concerning the examples I have collected of dogs specially restricted to a vegetable diet. I will continue to number them consecutively from where I previously left off.

No. 12. A good sized healthy dog, with the bull-terrier breed about it. Kept upon a diet of barley-meal and boiled potatoes, which it ate freely, for thirteen days. It was sacrificed four hours after being fed. Weight of dog 17½lbs.; weight of liver 1 lb. 3¼ ozs.

No. 13. A spaniel dog. Restricted to a diet of barley-meal and potatoes for nine days. It was in an exceedingly good condition, and appeared to have been getting fatter under this vegetarian mode of life. Fed at 8·30 a.m., and sacrificed six hours afterwards. Weight of dog 11½ lbs.; weight of liver 12½ozs.

No. 14. A spaniel dog, that had seven days previously been submitted to the operation of exposing the jugular vein to collect and examine the blood, after the introduction of 150 grains of grape sugar into the stomach. An exclusion to a diet of barley-meal and potatoes had been commenced a couple of days prior to this. It ate but little, however, appearing to dislike it. In this way it continued for five days, at the end of which time it looked considerably thinner. Some bread was now added to the other kind of food, and it then began to eat pretty well, and to exhibit signs of improvement, and in four days' time, when it was sacrificed, seemed in an ordinarily fair condition. Food was given to it in the evening, which it ate during the night. A fresh quantity was given to it again at 10 in the morning, of which, however, it would not take much. Life was destroyed three hours and a half afterwards, by pithing. Weight of dog 15¼ lbs.; weight of liver 11¾ ozs. Hepatine precipitate estimated one hour and a half after, 9·87 per cent.

No. 15. An oldish spaniel dog, with rather an abundant development of adipose tissue. Commenced with barley-meal and potatoes, which it ate well for three days. But it then

seemed tired of and refused this food. Some bread was therefore added, and with the desired effect. It now readily devoured what was given to it, and continued doing so for four days, when it was sacrificed, having eaten largely three hours previously. Weight of dog 18 lbs. 10 ozs.; weight of liver 1 lb. 12 ozs. Hepatine precipitate 25·30 per cent.

No. 16. An ordinary sized spaniel dog, that had been for eleven days kept on bread and boiled potatoes. It had readily taken to this kind of diet, and was sacrificed four hours after food had been given to it. Weight of dog 17 lbs. 5$\frac{1}{2}$ ozs.; weight of liver 12$\frac{1}{4}$ ozs. Hepatine precipitate 16·52 per cent.

Table showing the Weight of the Liver in the foregoing Examples under a Diet of Vegetable Food.

No.		Weight of dog. lbs.	ozs.		Absolute weight of liver. ozs.		Relative weight of liver to animal.
12	...	17	8	...	19$\frac{1}{4}$	...	1-14$\frac{1}{2}$th.
13	...	11	8	...	12$\frac{1}{2}$	...	1-14$\frac{1}{2}$st.
14	...	15	8	...	11$\frac{3}{4}$	...	1-21st.
15	...	18	10	...	28	...	1-10$\frac{1}{2}$th.
16	...	17	5	...	12$\frac{1}{4}$	...	1-22$\frac{1}{2}$d.
Total	.	80	7		83$\frac{3}{4}$		1-15th.

Taking the aggregate of these five examples, the liver of the dog under a vegetable diet more than equals in ounces the number of pounds the animal weighs. In Nos. 12 and 13, and still more especially in No. 15, the liver was of enormous comparative size. On opening the abdomen I was immediately and forcibly struck with the large appearance the organ presented. And, in looking back upon my past experience, I may positively state that I have never seen anything at all approaching it in the dog under a diet of animal food. The average proportion the liver holds in the five cases, is 1-15th the weight of the body, whilst it will be remembered the average proportion in the eleven cases under an animal diet was 1-30th, or exactly double.

Not only does it thus appear that the size of the liver in the dog is materially increased by the administration of a vegetable diet, but from the analytical results to be subjoined the increase seems especially if not entirely due to the relative amount of hepatine present. In Nos. 12 and 13 the actual

quantity of hepatine was not determined, but I am enabled to state that it was exceedingly large, for it was from these instances that I was first led to notice the point in question. A stream of water had been passed through the vessels of the liver to carry out the sugar, for the purpose of estimating the amount that was present. The water issued so strongly charged with hepatine as to be unmistakeably and widely different in appearance to anything I had ever before witnessed, notwithstanding I had at that time subjected upwards of twenty livers of dogs that had been kept upon an animal diet to a similar treatment. It is the property of hepatine when dissolved in water to give an opalescent or milky appearance to the liquid, so that its presence or absence, and even its relative amount, can be thus roughly estimated. In these two cases, notwithstanding the quantity of water passed through the liver amounted to nearly twenty pints, yet it was so opaquely-white that it had nearly the appearance of a fair specimen of milk. In No. 14 the animal did not take kindly to the diet supplied, and the per centage of hepatine named is lower than it fairly should be, on account of the liver not having been submitted to analysis till about an hour and a half after death.

In Ex. 12. ⎫ „ 13. ⎭	Quantity of hepatine exceedingly large, but the actual amount not determined.				
„ 14.	The liver yielded	9·87	per cent. of hepatine	precipitate	not examined till 1½ hour after death.
„ 15.	„	25·30	„	„	
„ 16.	„	16·50	„	„	

Average amount of hepatine precipitate given by the three livers examined, 17·23 per cent.

It is reasonable to presume that these striking results—that this striking increase in the weight of the liver, and the per centage of hepatine present under the influence of a vegetable diet, may be justifiably ascribed to the saccharine and amylaceous constituents in this kind of food. Indeed, as starch is converted into sugar in the alimentary canal, we may legitimately go further, and premise, that it is from sugar in reality that the extra amount of hepatine is produced, which gives to the liver its extra size. It need not be left, however, to a matter of inference only, for the following

observations on the administration of sugar with animal food speak in the most forcible language that can be desired. The sugar employed in these observations was the common moist or cane sugar which is consumed for domestic use. It is not often that dogs are to be found disposed to take this substance; except, perhaps, such fancy ones as from habit have acquired a taste for it. As these, however, are not the animals ordinarily encountered in a physiological laboratory, various devices had to be resorted to, in order to effect a deception. The plan I found to succeed the best, was to introduce the sugar into the interior of the small gut, of which the bundle of tripe is chiefly composed, thus making a kind of sugar sausages, of moderate length, and sometimes tied at either end. Even thus arranged, I could scarcely meet with a grown-up dog that would touch it; or at the most, eat it to more than an exceedingly limited extent. But with young dogs the deception proved of more avail, for these usually bolted what was thrown to them, without stopping to examine it, or to inquire into the taste of its contents. The following are the examples I have gathered. The numbers affixed are continued on from those belonging to a strictly vegetable diet.

The Liver of the Dog under a Diet of Animal Food, with an Admixture of Sugar.

No. 17. A nearly full-grown mongrel dog. Fed for eight days on sugar and a bundle of tripe a day. At first one third of a pound of sugar was given it daily, but after three or four days it showed a disinclination for food, vomited once, and had bilious diarrhœa. The quantity of sugar was reduced to a quarter of a pound daily, and with this amount it devoured what was given to it voraciously, and seemed now decidedly to acquire a fatter and better appearance. It was fed at 8·30 a.m., and sacrificed at 2 p.m. After death a little urine was collected from the bladder, which gave a strong saccharine reaction with the Barreswil solution. Weight of dog 10 lbs. 3 ozs.; weight of liver 12 ozs. Hepatine precipitate 12·80 per cent.

No. 18. A youngish dog. Fed for nine days on a bundle

of tripe and a quarter of a pound of sugar daily. At first it had eaten its food with great voracity, but during the latter few days it presented signs of distaste for the sugar. Still, however, with a little management, the full daily allowance was consumed. It required about an hour's coaxing to get it to take the whole of its last meal. Four hours afterwards, its life was destroyed by pithing. There was scarcely any urine to be procured, but what there was gave no saccharine reaction. Weight of dog 11 lbs. 14 ozs.; weight of liver 12¾ ozs. Hepatine precipitate 17·53 per cent.

No. 19. A middle-aged dog. Fed for eight days on a bundle of tripe and a quarter of a pound of sugar *per diem*, which it ate without difficulty. It was fed at 8·30 a.m., and sacrificed five hours and a half afterwards. The urine gave a slight reaction of sugar. Weight of dog 17 lbs. 11 ozs.; weight of liver 10¾ ozs. Hepatine precipitate 12·33 per cent.

No. 20. A young dog, not quite full-grown. Fed for five days on a bundle of tripe and a quarter of a pound of sugar daily. It devoured its food with great readiness, and at the end of the five days presented a most decided improvement in appearance, looking now considerably broader across the loins and better-conditioned than before. Previous to this diet being commenced, it had seemed quite thin and poor than otherwise. Its life was destroyed four hours and a half after it had been fed. The urine gave a strong reaction of sugar. Weight of dog 12 lbs.; weight of liver, 13½ ozs. Hepatine precipitate 15·37 per cent.

Table showing the Weight of the Liver in the foregoing Examples on a Diet of Animal Food with an admixture of Sugar.

No.		Weight of dog. lbs.	ozs.		Absolute weight of liver. ozs.		Relative weight of liver to animal.
Ex. 17.	...	10	3	...	12	...	1-13½th.
„ 18.	...	11	14	...	12¾	...	1-14½th.
„ 19.	...	17	11	...	10¾	...	1-26th.
„ 20.	...	12	0	...	13½	...	1-14th.
Total	.	51	12		49		1-16½th.

The average relative weight of the liver to the body in these four dogs bears a close approximation to the average of

the five under a vegetable diet. In example 19, the relative weight of the liver stands in marked contrast by the side of the others, and this brings down considerably the average on the four, which otherwise would have been greater than was even afforded by a diet of strictly vegetable food.

The amount of hepatine present is in each case greatly in excess of what has been noticed after a purely animal diet, and nearly accords with that which resulted from the influence of vegetable food.

Table showing the amount of Hepatine Precipitate furnished by the Liver after a Diet of Tripe and Sugar.

In Ex. 17.	The liver yielded	12·80 per cent. of hepatine precipitate.	
„ „ 18.	„	17·55	„
„ „ 19.	„	12·33	„
„ „ 20.	„	15·37	„

Average amount of hepatine precipitate yielded by the four livers 14·5 per cent.

It ought not to escape our observation that in the three instances, in which after the administration of sugar the liver presented such a large comparative size, the animals were scarcely full grown. In no subject, perhaps, so much as in physiology, is it requisite to take the widest possible view of every question, and to be constantly alive to the fallacies that may occur from the slightest modification in an experiment. The liver might be natural in the pup and, independently of the ingestion of sugar, of the size above noticed, unless we had found to the contrary. I believe the liver really to be, ordinarily to a slight extent, relatively larger in the young than in the grown-up dog; but the difference is very far indeed from such as would account for the fact that has been observed. I took some trouble to obtain the pup which formed example No. 11. It was in a perfectly healthy condition, and had been fed on tripe alone for some days before it was sacrificed. Its liver stood as high as the 1-21st part of the weight of the body, which is the largest proportionate size met with under that category. But if this be compared with the results given in the cases of the young dogs that were fed with sugar, the difference is exceedingly striking. In these the liver equalled the 1-13½th, the 1-14½th, and the 1-14th part of the

weight of the animal—proportions, it will be observed, which present the closest approximation to each other, and which give an average of the 1-14th for the three. In example No. 5, also, we have another instance of a young dog that had been fed upon tripe; but here the liver scarcely comes up to the average of the list to which it belongs. As regards the amount of hepatine present, this material was found in even the lowest of the four analyses after the administration of sugar, to be nearly double the average of those belonging to a strictly animal diet.

Besides the effects above mentioned, which result from the admixture of sugar with the animal food, the liver likewise presents an alteration in its physical appearance. Under an animal diet it is comparatively firm and fleshy, requiring considerable force to break it down between the fingers. Under the influence of the addition of sugar to the food, it becomes exceedingly soft, and is readily crushed by a very slight pressure. It gives one the idea of being swollen, and made soft. Its colour, also, has a decided tinge of pink. The bile I have noticed, too, of a much paler yellow than after a purely animal diet. There is another fact, I have in each case observed, after the administration of sugar, but which I do not at present attempt to account for, namely, that Peyer's patches, and the solitary glands of the intestines, especially the cœcum, undergo a most marked enlargement, and present a decided appearance of greater vascularity than usual. These structures may be naturally more developed in the pup than in the grown-up dog; but in the pups I have examined I have never seen anything approaching the condition I am alluding to. In three out of the four cases, as mentioned in the particulars, the allowance of sugar that was given communicated to the urine a saccharine quality; and it is worthy of note that, notwithstanding cane sugar was administered, it was the reaction of grape sugar that was obtained in the urine.

I have made several observations on the amount of hepatine in the rabbit, and the relative size of the liver. In these observations I have met with the greatest variety, which I attribute to the sickly condition in which London rabbits are too often found. I frequently notice, on buying a number of rabbits, that although they may appear strong and lively at the

time, yet, after keeping them a little while, they begin to die off; and on examining them after death, their livers are found extensively diseased, and pervaded with entozoa. To obtain a a representation of the condition of the perfectly healthy liver of this animal, it will be necessary to procure some strong and vigorous rabbits from the country, and sacrifice and examine them immediately. Meanwhile I may mention the leading points of what may be taken as an average sample of those that have occurred under my notice. In looking at the relative weight of the liver in the rabbit, it must be especially borne in mind how large a quantity of perfectly extraneous matter is estimated with the weight of the animal. The intestinal canal is exceedingly long, and the contents, especially of the stomach and the very large cæcum, exceedingly bulky. The stomach and intestine, in fact, with their contents, in the two instances that I have specially noted, have equalled the 1-5th and the 1-5½th of the weight of the body. In the dog the proportion is very much less. In one dog that had been kept on a vegetable diet, the alimentary canal and its contents constituted nearly the 1-8th part of the weight of the animal; whilst in another that had been well fed on an animal diet, the proportion was only the 1-10th.

Observation.—A rabbit in good average condition. Weight of animal 5 lbs. 3 ozs.; absolute weight of liver $3\frac{3}{8}$ ozs.; relative weight of liver 1-24th. Hepatine precipitate 7·5 per cent.

Observation.—A rabbit in a poor condition, but lively and otherwise apparently well. Weight of animal 3 lbs. 15 ozs.; absolute weight of liver $2\frac{5}{8}$ ozs.; relative weight of liver 1-24th. Hepatine precipitate, 6·69 per cent.

Observation.—A rabbit in a strong and apparently healthy condition. It had been submitted to the operation of injecting sugar into the circulation through the jugular vein, and was sacrificed about an hour afterwards, the injection having produced no sensible disturbance. Weight of animal $7\frac{1}{2}$ lbs. oz.; absolute weight of liver $3\frac{3}{8}$ ozs.; relative weight of liver 1-33d. Hepatine precipitate 3·16 per cent.

Observation.—A rabbit, as near as possible to all appearances, in a similar condition to the last. It was also submitted to a similar operation, and sacrificed about the same time afterwards. Weight of animal 5 lbs. 11 ozs.; absolute weight of liver $3\frac{1}{4}$ ozs.;

relative weight of liver 1-28th. Hepatine precipitate 12·59 per cent.

Quite recently I have performed a couple of experiments on some rabbits. The results are most strikingly corroborative of the deductions I have drawn from the observations on the dog.

In the first experiment, I took a couple of about half-grown rabbits, as near as possible resembling each other. One I kept without any food at all, whilst the other was fed daily for three days with an ounce of cane sugar, and an ounce of starch made into a semifluid mass with water, and injected by means of a tube passed down the œsophagus into the stomach. On the fourth day an examination was made as to the relative weight of the liver and the amount of hepatine present.

The rabbit which had received no food. Weight of animal 1 lb. 14 ozs.; weight of liver 1 ozs. Amount of hepatine precipitate 1·4 per cent.

The rabbit which had been submitted to the diet of starch and cane sugar. Weight of animal 1 lb. $14\frac{3}{4}$ ozs.; weight of liver $2\frac{3}{8}$ ozs. Amount of hepatine precipitate 16·9 per cent.

In the second experiment two full-grown rabbits were taken, also as near as possible resembling each other. One was kept entirely without food; the other was fed in the same manner as the above, with one ounce of starch and three quarters of an ounce of grape sugar daily for three days. On the fourth day both animals were killed, and an examination made. I noticed in this as in the preceding experiment, that the liver of the fasting rabbit was dark-coloured and of a somewhat fleshy consistence, whilst the other was exceeding pale in colour, and so soft as to be almost pulpy.

The rabbit which had received no food. Weight of animal 3 lbs. 1 oz.; weight of liver $1\frac{2}{5}$ oz. Amount of hepatine precipitate 1·3 per cent.

The rabbit which had been restrictcd to starch and grape sugar. Weight of animal 3 lbs. 4 ozs.; weight of liver $2\frac{4}{5}$ ozs. Amount of hepatine precipitate 15·4 per cent.

It is not my inttention at present to enter into a consideration of what naturally becomes of the hepatine during life. One fact may be regarded as certain from what has preceded—that hepatine is not naturally formed for the purpose of

transformation into sugar. It does not itself escape as hepatine from the liver; and the only likely channels of exit for the product of its metamorphosis, are through the hepatic veins or biliary passages, for it is scarcely probable that the lymphatics can be subservient to this purpose. From what I have seen, I anticipate that our attention will have to be specially directed to the bile and to the production of fat—a material which the evidence of observation leaves no doubt must be largely manufactured, particularly under certain kinds of vegetable food, in the animal system. I believe our knowledge to be exceedingly imperfect concerning the bile, and that one of its chief purposes in the vegetable feeder is comparatively passed over in insignificance. Certain it is, that the constitution of the bile widely differs, even in different members of the mammalian class. The bile of the rabbit and the dog I may cite as an illustration of this fact; the former leading to the production of a strongly chylous or milky appearance, from the precipitation of a white matter, when treated with the acid liquid derived from the stomach, or with a drop or two of the acetic or any other acid; whilst the latter gives no appreciable change upon being submitted to a similar treatment.

Thus much may be stated regarding the transformation of hepatine—that a total disappearance from the liver may be effected in a very short time, and, it is important to remark, without any sign whatever of the production of sugar. Anything seriously disturbing the functions of life causes the liver to be free from hepatine. It is seldom found in the liver of the human subject, because a morbid state of the system has existed previous to death. I may refer to the following examples to show how soon the liver may be deprived of its hepatine.

A strong healthy rabbit was oiled on its surface, and exposed to a degree of cold that occasioned its death in four hours. No hepatine existed in the liver, and not a trace of sugar was to be found in the liver or blood.

Another full-grown and vigorous-looking rabbit was similarly treated, and exposed to cold from the effects of which it died in two hours and three quarters. No hepatine was to be discovered in the liver after death.

If the cold be such as to produce death with much greater rapidity than in the preceding instances, then hepatine is found to be present in the liver. A half-grown rabbit, which presented a fair conditioned appearance, was oiled on its surface and at once exposed to great cold, combined with the effects of a strong current of air. In thirty-five minutes' time it appeared almost dead, and would probably have died in the course of a few minutes. The liver gave 10·79 per cent. of hepatine precipitate.

In a healthy dog into the stomach of which I had injected 200 grains of carbonate of potash dissolved in two ounces of water through an œsophageal tube about an hour after a meal, the liver was found entirely devoid of hepatine, and a likewise of sugar after death. The animal, when I left it in the evening after the operation, did not appear to be in anything approaching a dying state. It had, however, succumbed during the night, and was found stiff and cold the next morning.

The properties that hepatine possesses are exceedingly marked and characteristic. When pure, it is a neutral, colourless, tasteless, and inodorous (solid) substance, apparently unsusceptible of assuming a crystalline form, and when precipitated with spirit presenting an amorphous granular appearance under the microscope. Its physical appearance differs according to the mode of preparation that has been adopted. The scum which collects on the surface of a solution of hepatine heated to evaporate down, dries into an exceedingly brittle, semi-transparent, gum-like or resinous-looking body. In this state it also resembles gelatine, but is much less tenacious, and easily separates from the surface on which it dries. When thrown down from its aqueous solution by alcohol, it falls as a white flaky precipitate, which soon subsides. And if this white precipitate be *quickly* dried, an opaque, white, friable mass is the result, which is easily reduced to a powder; but, if *slowly* dried, the particles seem to run or cohere together, and thus to form a hard, semi-transparent material, which is much more difficult to powder. It does not attract moisture from the air, but is soluble to an exceedingly large extent in water, although the process of solution occupies a considerable time before it is perfectly effected. When moist or in aqueous solution, it soon becomes mouldy on the surface upon being ex-

posed to the air. The moderately concentrated solution presents an exceedingly milky appearance, which requires a very large quantity of water to remove. In an exceedingly concentrated state, however, it loses its resemblance to milk; so that, on evaporating a moderately dilute solution of hepatine to a highly condensed consistence, it gradually clears until it has become nearly transparent. On thus evaporating its solution, the hepatine is continually collecting in the form of a scum on the surface, and also to a certain extent accumulating on the bottom of the evaporating dish. Its insolubility in alcohol, and its power of resisting the action of a boiling solution of potash, are properties that have been made use of for effecting its quantitative determination in the liver. It is thrown down as a flaky precipitate, when, in a concentrated state, it is poured into glacial acetic acid or into a saturated solution of sulphate of soda. By dilution with a little water, however, the precipitate is in each case rapidly re-dissolved. Its reaction with iodine is exceedingly marked, and corresponds to that of dextrine, producing a wine-red or deep blood-red colour, which approaches to black when strong solutions are employed.

One of the most striking features of hepatine is its extreme susceptibility of transformation into sugar. Boiling for a short time with the sulphuric or nitric acid, and contact with animal substances that are capable of acting as ferments, readily effect this change. The saliva, the blood, and the tissue of the liver, all act with great energy in this way, especially at a moderately elevated temperature; hence the production of sugar in the dead liver, and even in the liver which has been deprived of its blood by a stream of water passed through its vessels. What I regard as an extremely interesting and possibly important fact, is, that contact with the saliva at the temperature of about 100°, leads to an almost instantaneous production of sugar, when the solution of hepatine is neutral; but, if a drop or two of either an acid, alkali, or a carbonated alkali be added, the change is to an astonishing extent interfered with. The hepatine which is precipitated by spirit from a plain decoction of the liver is acted upon with great rapidity by saliva, whilst the hepatine which has been precipitated from a potash solution of the liver, and which always carries down

a little of the alkali with it, offers such resistance that nothing more than an extremely tardy conversion into sugar takes place. Neutralised, however, with just a sufficiency of acid for the purpose, and the change is immediately effected, whilst if too much acid have been added the action is again checked or retarded. Seeing that the transformation of hepatine into sugar takes place so instantly and so largely upon the destruction of life, it is reasonable to presume that it always naturally exists in contact with materials which must have a constant tendency to act as ferments. The point that has yet to be learnt is the precise nature of the circumstances that check during life the change into sugar. For the solution of this question, it is probable, much more extended observation will be required. But, in the meantime, we cannot fail to look with interest upon the fact, that so slight a cause as the presence of a trivial amount of acid or alkali is sufficient almost completely to prevent the action of saliva in effecting a transformation into sugar. It may be just thrown out as a possible conjecture, that the hepatiue is in a state probably of combination during life which enables it to resist the tendency of ferments to change it into sugar; but that with the destruction of life, this state is no longer maintained, and then its saccharine metamorphosis ensues.

I am ignorant at present of the exact constitution of hepatine, but, upon the authority of Bernard, it is a body destitute of nitrogen. I have conducted some analyses with the view of determining the relation of loss and gain that accompanies the disappearance of hepatine and the production of sugar. The following are the results I have obtained. In the first three determinations, a part of the liver was instantly after death thrown into a freezing mixture, whilst the other was allowed to remain some minutes in the animal. The freezing mixture checked the transformation of hepatine, which was taking place in the specimen where the temperature had not been lowered. By making an analysis of the two portions, the data are given for estimating the amount of sugar that was gained for the loss of hepatine that took place. In the last example, instead of a part of the liver being submitted to the influence of cold, the whole liver was simply removed from the animal and examined at once; and then again in

twenty-four hours time. During the interval that elapsed, sugar was slowly taking the place of the hepatine, and with the results that are furnished by the two examinations, the relation of the loss of the one to the increase of the other is displayed.

No.	Amount of hepatine lost.	Amount of sugar gained.	Relation of increase of sugar to decrease of hepatine.
1	... 2·20 per cent. ...	1·57 per cent. ...	1-1·40.
2	... 7·04 „ ...	4·25 „ ...	1-1·65.
3	... 3·12 „ ...	2·05 „ ...	1-1·52.
4	... 1·82 „ ...	1·12 „ ...	1-1·62.

Taking the medium of these results, it may be stated, unless the disappearance of hepatine should prove to be in part due to another process besides its conversion into sugar, that the production of one part of sugar is attended with the loss of one part and a half of hepatine. The results of the analyses are sufficiently near to justify us in regarding this statement as in all probability presenting a close approximation to the truth.

Whatever in future may be definitely shown to be the particular purpose of hepatine in the economy of life, the facts I have brought forward lead irresistibly, in my own mind, to the conclusion that it is not formed for the object, as has been thought, of transformation into sugar. Experiment leaves no doubt that this transformation may be, and with great facility is, effected during life, but it is under conditions deviating from the ordinary or normal state.

In Brown-Séquard's 'Journal of Physiology' for April, 1858, M. Sanson, of the Veterinary School of Toulouse, has published some recent observations on the origin of sugar in the animal economy. Ignorant of the facts I have just detailed, he believes the liver to be charged with sugar during life, but attacks the glucogenic theory of Bernard with somewhat similar weapons to those previously used by M. Figuier. M. Sanson, however, has extended his researches beyond those of M. Figuier, and has made investigations regarding the so-called sugar-forming substance discovered by Bernard, of which my communication has been treating. He considers that there is only one source for the sugar met with in the animal economy, and that this one source is exterior to the body—

the sugar, in fact, found in the system, both of the animal and vegetable feeder, is derived from the food.

According to M. Sanson, the glycogène, or sugar-forming substance of Bernard, is nothing but dextrine, which, he says, does not belong *specially* to the liver, but is found in the blood and the various structures of the body. Again, the liver, he says, is not an organ for producing the glycogène, but simply for abstracting it from the blood and transforming it into sugar with greater activity than is elsewhere effected. Bernard's experiments, he considers, prove only that sugar is absent in the blood going to the liver, and present in that coming from it. They do not prove, according to M. Sanson, that the change of glycogène into sugar which takes place in the liver is the result of a process of secretion. He looks upon it as a simple chemical change, because it also takes place after death.

The facts I have brought forward, which show that sugar does not belong to the healthy liver *during life*, as was formerly believed, so alter the position of this subject as to render unnecessary the discussion of whether the production of sugar results from a process of secretion or of a simple chemical transformation.

From what has also preceded, it will further be seen that my experiments do not sustain the views of M. Sanson. As far as I have yet gone I am led to regard the so-called glycogène as a material particularly belonging to the liver, and secreted by it from saccharine, amylaceous and other principles contained in the blood circulating through its capillaries. My experience does not extend much to the herbivora, but in the case of the carnivora I have not found this substance distributed throughout the system as is represented by M. Sanson. I have previously mentioned having treated the spleen and kidney of the dog for the extraction of hepatine, but without effect. I have since, upon two occasions, repeated the examination, and with a precisely similar result. From the lung and muscular tissue, however, a small quantity of a substance can be extracted, which, like hepatine, is susceptible of transformation into sugar under the influence of saliva, and also of being coloured by iodine. As regards the blood, I am again unable to account for the discrepancy that exists between the

statements of M. Sanson and the results of my own observation. I have failed in detecting any sugar-forming material in the blood when withdrawn from the dog under natural circumstances, and I have not noticed blood become saccharine on being allowed to repose after removal; indeed, the result of my experience is to the contrary, as will appear from the facts mentioned in a previous number of the 'Guy's Reports,'

ON

POISONING BY NICOTINA,

WITH REMARKS.

By ALFRED S. TAYLOR, M.D., F.R.S.

M. W—, æt. 36, a gentleman well acquainted with chemistry, had been for some months in a state of great depression of mind. He thought that he was incompetent to the performance of his duties, and that he had chosen a profession for the practice of which he had neither the mental capacity nor the pecuniary means. He had spoken of suicide, and it appeared that five months before his death he had casually remarked in conversation, that if at any time he took poison, he would select nicotina,[1] because it was certain in its action, and would kill a person quickly. This remark was made in reference to a case of suicide by poison in which death did not take place until after the lapse of some hours. For several weeks previous to his death, he appeared distracted and broken down by over-anxiety as to his professional prospects. It was noticed that he did not rest at night, and that he neglected matters which were entrusted to him professionally. He owed for chemical apparatus a small sum of money, which he was quite able to pay; but on this point his mind had evidently been much excited by exaggerated conscientious feelings. A literary engagement involving great labour and research also

[1] This alkaloid of tobacco is frequently but incorrectly called *Nicotine*. The final "ine" is properly applied only to organic principles, the alkaline nature of which has not been determined, but this, like strychnia or morphia, is an alkaline base and it should therefore have a terminal syllable which marks at once its true nature. Some writers describe it under the name of *Nicotia*.

oppressed him. After having deliberately and by the advice of his friends signed the agreement, and entered upon the work satisfactorily, he allowed his mind to be haunted with the idea that he could not execute the task, and that he had neither the knowledge nor capacity to complete that which he had undertaken.

On the night of Friday, June 18th, 1858, it was remarked that he did not return as usual to his lodgings: but from what subsequently transpired, it appeared that he passed the night in a water-closet at the Institution in which he held an appointment. At a little before 8 o'clock on the morning of Saturday, the 19th June, a servant who was passing heard a noise near this closet, and gave an alarm. One of the assistants arrived just in time to catch the deceased in his arms, as he fell forward on the floor from within the closet. By the mere weight of his body in falling, the door of the closet was thrown open before him. Aided by another man, the assistant carried deceased to a table in an adjoining room, but before they could reach it, he was dead. From the statement made by those who were present, the deceased did not at first appear to be wholly unconscious, but it was observed that he stared wildly with his eyes: there were no convulsions, and he died quietly, heaving a very deep sigh in expiring. Before he died, he did not appear to know or recognise those who were around him. On entering the closet, besides a knife, handkerchief, and other articles, there was found a small bottle with a stopper in it. It contained about half a drachm of a brownish-coloured liquid, and had a capacity of from six to eight drachms. It was observed that there was a peculiar smell in the closet, which, however, those who were present could not recognise or identify as having any particular character.

About ten minutes after death, the body of deceased was seen by a medical gentleman. He did not perceive, either about the body or mouth, any odour which could lead him to suppose that deceased had taken nicotina. The only odour which he perceived was that of ether, and it is not improbable that the deceased had mixed some ether with the nicotina, which it was afterwards proved he must have swallowed. The other appearances noticed at this time, were, that the limbs were flaccid,

and all the muscles perfectly relaxed, the eyes were staring and prominent, the features were bloated, and beginning to present a livid discoloration, and it was remarked that there was a puffiness or great fulness about the neck. There was no appearance of convulsion or tetanic rigidity. The fingers were simply closed over the palms of the hands, as it is usual to find them in death. No odour resembling tobacco was at this early period perceived by any of those who were present. Fragments of a label were found, and these when put together revealed the word "Nicotine." The bottle lying near the deceased was missing from its usual place in the laboratory; but whether it was or was not full when removed by the deceased, there was no evidence to show.

On searching his pockets, there was found a letter on which he had recently written,—"I have chosen a profession above my capabilities and the means of my friends."

The body was examined sixty hours after death, the temperature being at the time above 70°. Externally, decomposition had advanced to a great extent; but there was no odour of nicotina or any smell resembling that of tobacco. The only perceptible smell was that of ordinary putrefaction. When the body was again seen, seventy-eight hours after death, the features were much bloated and distorted, resembling those of a person who had died by drowning, and whose body had been exposed in hot weather. The skin was of a greenish-white colour, except in the course of the great venous trunks, where for some space on each side it had assumed a deep green colour. The neck was greatly distended, and putrefaction had obviously gone on to some extent in the course of the large veins: these appeared full, and as if the blood in them were much decomposed. The sides of the face in the bloated parts, and the sides of the chest in the whole of the intercostal spaces, had a deep blueish-green colour, as if from the decomposition of blood effused in the cellular tissue. The green colour was observed also on the skin of the back, and in all the dependent parts of the body. The limbs were relaxed: the lower extremities and feet presented no unusual appearance, but the arms were beginning to be decomposed.

About the upper end of the chest-bone, and at the root of the neck, there was a diffused spongy swelling of the skin,

crepitant under pressure, and discoloured by putrefaction. When this was pierced by a knife, gas escaped, followed by a discharge of dark fluid blood from the areolar tissue in which it had been effused. The mucous membrane lining the lips and mouth was not excoriated. On dividing the scalp, dark liquid blood was found effused to a very unusual and remarkable extent, through the structures covering the cranium. On opening the head, the meningeal vessels and those of the brain generally were turgid with black fluid blood. The substance of the brain was healthy, of a darker colour than usual, and the cortical portion presented a green-grey tint. On slicing the brain, few or no bloody points were observed. The ventricles contained a few drachms of serous fluid. In the chest, the lungs were found filling the pleural cavities, highly crepitant, and presenting on section a remarkable engorgement with black blood, resembling in colour and appearance black currant jelly. The heart was somewhat small, of a fawn colour and very flabby. The cavities were empty, with the exception of the left auricle, which contained about two drachms of blood, resembling in colour and fluidity that found throughout the body. The stomach was distended with gas, and externally it did not present any unnatural appearance. It contained a small quantity of chocolate-coloured fluid of a treacly consistency. When this was removed, the whole of the mucous membrane presented a dark crimson-red colour, as if stained with black currant-jelly. There was the most intense congestion of the whole of the capillary vessels, but there was no abrasion, corrosion, or destruction of the coats. These were not softened: they had their usual tenacity and strength. The deep crimson colour of the mucous membrane was especially marked at the cardiac end of the stomach. No odour resembling nicotina or tobacco could be perceived on opening the cavities of the body, and the stomach and its contents had merely the smell arising from incipient putrefaction. The liver and lungs were almost purple-black from the amount of congestion in their capillary structure. The blood was liquid, but in some parts thickened to the consistency of treacle—the fibrin appeared to be broken up and destroyed. Its colour was peculiar, resembling that of black currant juice. The stomach and contents, with the blood and other portions

of the viscera, were secured in a bottle, and submitted on the day following the inspection, to a chemical examination.

Analysis.—One half of the stomach with the adhering contents was cut into small pieces and shaken with a quantity of ether in a bottle. The contents were allowed to digest for an hour, being occasionally shaken. The ethereal liquid, which had acquired a yellow colour, was then poured off and spontaneously evaporated. The residue had no particular odour; it was a soapy-looking mass having an alkaline reaction. This residue was mixed with a solution of pure potash and distilled, at first at a low, and afterwards at a high temperature. A small quantity of colourless liquid was obtained, which had a well-marked alkaline reaction. There was no odour of ammonia, but a peculiar odour which bore some resemblance to nicotina much diluted with water. On warming a portion, test-paper applied to the vapour indicated a slight volatile alkaline reaction. Chloride of platina gave a yellowish crystalline precipitate, presenting well-defined feathery prisms under the microscope; corrosive sublimate gave a white precipitate; arsenio-nitrate of silver, a bright yellow precipitate; iodine water a turbid reddish-brown precipitate; tannic acid a yellowish-white precipitate; and gallic acid produced in it no precipitate and no change of colour. A portion of the liquid allowed to evaporate spontaneously, left some oily-looking globules, which, on being heated, evolved acrid pungent fumes, resembling nicotina. The soapy residue in the retort was mixed with a sufficient quantity of hydrate of lime to render it a stiff paste, and this was submitted to distillation. An additional quantity of a clear colourless liquid was obtained, which had the odour of nicotina, was strongly and fixedly alkaline, and gave with the tests all the results above described. A portion of this was neutralized by diluted hydrochloric acid slowly evaporated on a glass slide. When examined by the microscope no dagger crystals of hydrochlorate of ammonia were obtained, showing an entire absence of this alkali.

The liver and lungs had been placed in the same bottle with the stomach (cut open), and its contents, so that no inference of absorption and deposition could be drawn from a separate analysis of those portions of the organs which had been reserved.

The remaining half of the stomach, as well as the portions of liver and lungs, were cut into small pieces and divided into equal parts, for the purpose of separating nicotina by the processes of ORFILA and STAS, in order that a comparison might be made of their relative value.

Orfila's process—The portions of viscera were placed in a glass vessel, containing five ounces of distilled water, to which five drops of pure sulphuric acid had been added. The animal matter was well stirred with the feebly acid liquid, and allowed to stand for about forty hours. It was then strained and filtered, and the residue pressed. The object of this stage is to produce sulphate of nicotina. As the alkaloid is liquid, and easily unites to acids and forms salts, no heat is required for solution or combination.

2. The highly coloured acid liquid thus obtained was evaporated in a water-bath to one half, and this led to the separation of a thick coagulum. Cold alcohol of a sp. gr. of ·826, was poured on the acid liquid and well mixed by stirring it. This caused a further coagulation. After a short digestion it was filtered, and a clear liquid of the colour of pale sherry wine was thus obtained. The greater part of the organic matter had been thus effectually separated. The liquid was evaporated over a water-bath, and the fatty residue which resulted, was separated by agitation with a small quantity of water and filtration through a wet filter.

3. The aqueous solution procured amounted to four fluid drachms: it was feebly acid, and slightly coloured. It was rendered alkaline by pure potash, and shaken with its volume of pure ether in a stoppered tube. The ethereal liquid was decanted, and portions were allowed to evaporate spontaneously in a number of watch-glasses. Oily-looking globules were obtained in each case. These had the peculiar odour of nicotina, which was only strongly evolved when the watch-glass containing them was heated. The odour was acrid and pungent, affecting the nostrils and throat, and producing headache. The oily-looking residue in each watch-glass was mixed with a few drops of water. It was readily dissolved, and had a strong alkaline reaction. The reagents above mentioned were applied to the solutions thus obtained with the most conclusive and satisfactory results. Chloride of platinum

produced the feathery crystals (visible under the microscope) which it produces with a solution of nicotina, Tannic acid gave a dense yellowish-white, and iodine water a red-brown precipitate, and it was found that a solution of permanganate of potash had its colour immediately discharged.

Stas's process.—Five ounces of distilled water, in which eight grains of crystallized oxalic acid were dissolved, were used for the solvent in this case. The remaining portions of the viscera were digested in this liquid, and the subsequent steps of the process were in all respects similar to those above described. The differences observed were: that the various solutions obtained were of a darker colour; and the quantity of nicotina removed from the viscera by the oxalic acid was larger and in a more concentrated form. The globules of nicotina obtained had a stronger alkaline reaction when dissolved in water, and the precipitates obtained by the reagents were more copious.

Neither of these processes will enable the analyst to separate the whole of the nicotina from the organic matter. In order to determine this question, the brown, watery, alkaline liquid, which remained in the tube after agitation with successive quantities of ether was, in each case, distilled; and a clear, watery product was obtained, containing nicotina and ammonia. By exposure in a dial-glass for twenty-four hours, the whole of the ammonia had passed off, and the oily-looking globules left as a residue were found to consist of nicotina. A larger proportion was obtained from the residue of the sulphuric acid process than from the residue of the oxalic acid process, showing that a greater quantity had been extracted by ether in the process of *Stas*.

It was thus proved that nicotina was present in the body of the deceased. The result of the inquest was that the deceased had died from the effects of nicotina, which he had voluntarily taken for self-destruction while labouring under temporary insanity. The circumstances rendered it probable that deceased had procured the bottle of nicotina from the laboratory in the evening he that had retired to the water-closet, and had remained there the whole of the night; that on hearing persons moving about in the morning, he swallowed a quantity of the poison from the bottle, returned the stopper, and

had probably intended to conceal the means of death by throwing the bottle down the closet: but he fell forward powerless in the act, and the bottle dropped from his hand. The label had been previously scratched off. The quantity of this poison taken by him cannot therefore be determined; it is probable that the greater part of the contents of the bottle were spilt. It is well known that two or three drops of nicotina are sufficient to destroy life; and that this quantity at least had reached the stomach is rendered probable by the result of the chemical analysis. The time which he survived after taking the poison must be a matter of inference. It may be assumed from the circumstances, that he was insensible and powerless within a few seconds, and that he died in from three to five minutes. There were no convulsions. The poison appears, in this case, to have acted as a pure narcotic.

This is, so far as I can ascertain, the only case of poisoning by nicotina, which has occurred in this country. There is only one other on record: this occurred in Belgium, and was the subject of a trial for murder in 1851. The Count and Countess Bocarmé were charged with the murder of the Countess's brother, a M. Fougnies, by administering to him nicotina, while dining with them in the château of Bitremont. The deceased did not survive more than five minutes, and was not seen living by any of the attendants. The possession of the poison, as well as the moral evidence, fixed the crime on the count, and he was condemned and executed. The appearances after death in the case of Fougnies were, to a great extent, altered or destroyed by the pouring of some strong acid (acetic) into the mouth and over the body of the deceased, in order to conceal or remove the odour of nicotina. M. Stas conducted the chemical investigation, and succeeded in detecting the poison in small quantity in the tongue and fauces, stomach, liver, lungs, and in a wooden plank of the floor of the room in which the deceased was sitting.

Properties of nicotina; its effects on animals.—A specimen of this alkaloid was given to me by Dr. Hofmann. It had a pale amber colour: when poured from the bottle it flowed like a thin oil: it gave a greasy stain to paper, which was speedily removed by evaporation; and it evolved a peculiar

odour resembling stale tobacco smoke. When heated on platina it produced a dense, white smoke, acquired a dark colour, took fire, and burnt with a bright yellow flame, giving off an abundance of carbon as a thick, black smoke, and leaving a small quantity of carbon as a residue.

Strong sulphuric acid in the cold did not carbonize it, but the nicotina acquired a reddish colour, which was deepened by heat. When the heat was continued, the mixture became darker, and white vapours of sulphurous acid, as well as of nicotina, were evolved. Sulphuric acid in the cold, with a crystal of bichromate of potash, produced, after a time, a green colour, from the separation of oxide of chromium. Fuming hydrochloric acid brought near to a drop of nicotina, produced dense white vapours of the hydrochlorate, resembling those caused by ammonia under the same circumstances. When heated, the hydrochlorate of nicotina escaped in dense, white vapours, leaving as a residue a carbonaceous stain. Nitric acid produced in the cold no change, but when heated the mixture acquired a dark orange colour. After a time, the acid was suddenly and violently decomposed with the evolution of nitrous acid vapour.

Nicotina, in a concentrated state, is powerfully alkaline. Two drops dissolved in an ounce of distilled water gave to the liquid a strong alkaline reaction. The solution, in this diluted state, had the peculiar odour of the alkaloid. A piece of paper dipped in pure nicotina, when ignited, burnt with a yellow smoky flame, as if it had been dipped in oil. It is very soluble in water, alcohol, and ether; and ether possesses the property of removing it, although not entirely, from its aqueous solution. The solutions have the odour and the other chemical properties of the alkaloid. In spite of its powerful odour, nicotina does not appear to be very volatile. It remains as a greasy-looking spot in a watch-glass, after many hours' free exposure to the air; and even after twenty-four hours, the application of heat to the thin film of moisture in the glass, led to the evolution of the peculiar pungent odour of this alkaloid. The vapour evolved from the pure alkaloid does not perceptibly affect test-paper like that of ammonia, although there are abundant white fumes produced on exposure to hydrochloric acid in both cases. If ammonia

should be mixed with nicotina, that alkali is removed with the water by simple exposure. The hydrochlorate of ammonia forms permanent dagger crystals; the hydrochlorate of nicotina is deliquescent, or only imperfectly crystallizes in short wide prisms crossing each other at right angles.

Nicotina strikingly resembles ammonia in some of its properties, and as ammonia may result from the action of potash on organic matter, especially when heat is employed, it is necessary that an analyst should have the means of distinguishing nicotina from ammonia, and of separating one from the other. They both produce an orange-yellow precipitate with chloride of platina: when examined by the microscope the ammonia-precipitate is in octahedra or dodecahedra—the nicotina-precipitate is seen in groups of feathered crystals peculiar in shape and arrangement, mixed with well-defined octahedra. Both ammonia and nicotina are precipitated of a yellow colour, by arsenio-nitrate of silver, and white by corrosive sublimate. The striking chemical reactions in which they differ are these: iodine water has its colour discharged by ammonia; it is precipitated brown by nicotina: tannic acid produces a red colour with ammonia, without precipitating the alkali; it precipitates nicotina of a pale yellowish-white, like the other alkaloids, but produces no change of colour: traces of ammonia are thus easily detected in a solution of nicotina by this reagent. Gallic acid rapidly imparts to ammonia a pink-red colour, while it produces no change of colour or precipitate in nicotina. The red colour produced by ammonia slowly changes to an olive-green. Chloride of gold gives an amorphous brown precipitate of fulminating gold with ammonia, while it produces a plumose crystalline precipitate of a yellow colour in a solution of nicotina. Nitrate of silver yields with ammonia brown oxide of silver, soluble in an excess of the alkali; with nicotina it produces an opalescence not soluble in excess; and, on heating the mixture, silver is slowly reduced and separated. Permanganate of potash is scarcely affected in its colour by admixture with ammonia; but the colour is rapidly destroyed by nicotina even in a very diluted state. As ether and most organic substances discharge the pink colour of the permanganate, care must be taken that the nicotina is not combined with any of these matters. When

we know that we are dealing with nicotina alone, a standard solution of permanganate of potash may be employed to determine the quantity present. The quantity of permanganate which has its colour discharged on admixture with a certain measure of nicotina, will be great in proportion to the strength of the alkaloid; and if the solution of permanganate be previously tested with a measured quantity of nicotina, the proportion present in an unknown case may be thereby determined. A solution of two drops of nicotina to one ounce of water is sufficiently strong to give all the reactions above described.

As a summary of these distinctions between ammonia and nicotina, it may be stated, that nicotina is specially identified by its strong and peculiar odour, wholly unlike that of ammonia, either in the cold or when heated—by the precipitate, without change of colour, given by tannic acid—the reddish brown precipitate by iodine water—and the immediate destruction of the colour of a solution of permanganate of potash.

If ammonia is mixed with nicotina, it may be separated either by spontaneous evaporation, or the mixture, neutralized by diluted sulphuric acid, may be carefully evaporated to dryness, and the residue treated with alcohol. Sulphate of nicotina is dissolved, whilethat of ammonia remains.

Experiment on a rabbit.—A single drop of the pure nicotina, examined in the above-mentioned analysis, was placed at the back of the mouth of a healthy rabbit. The taste appeared to be affected, the animal frothed at the mouth, and a quantity of frothy mucus issued from between the jaws, which were closed.

Symptoms.—In from fifteen to twenty seconds the animal lost all power of standing on its legs; it fell on its side, and was violently convulsed in its fore and hind legs; these were in rapid motion for half a minute, and the back was arched in opisthotonos, but again speedily relaxed. The animal then lay tranquil for about a minute, when it was again suddenly seized with similar clonic convulsions; these ceased, and the animal appeared to be dead. The heart continued to contract for about half a minute, and then ceased. The animal died in three minutes and a half from the time at which the poison

was placed in its mouth. During the convulsions, and after death, it was observed that a quantity of frothy mucus escaped from the mouth. This was strongly alkaline, and it was supposed to have the odour of nicotina; but as the air of the room was impregnated with the vapour, nothing certain could be said on this point.

Appearances.—The body was examined in an hour and a half after death. The eyes were prominent and staring; the limbs were relaxed, but these became rigid about half an hour later. On opening the abdomen the stomach was found distended with food. When laid open, the only odour perceptible was that of sour green food. The coats were pale; and the blood-vessels were strongly marked in their course by the dark-coloured blood which they contained. The intestines were pale, but there was great congestion of the vessels of the mesentery. The liver and kidneys were congested with dark-coloured blood; the lungs were pale and not congested; the right cavity of the heart contained a small quantity of blood of a dark colour, and in a partially coagulated state. The left cavities were empty; the blood which escaped during the inspection was fluid, and of a dark, claret-red colour, with a pinkish tinge when seen in a thin layer; on exposure to the air it became lighter in colour, but did not pass to a florid red. The colour of the blood was similar to that which I have occasionally seen in poisoning by prussic acid and the essential oil of bitter almonds.

Analysis.—The parts removed for analysis were: 1, the stomach and its contents; 2, half an ounce of blood collected from the vessels of the abdomen; 3, the liver; 4, the heart, kidneys, and lungs; 5, the tongue, palate, and soft parts adjacent. None of these organs or parts had the odour of nicotina. This was only perceptible near the mouth of the animal, but it rapidly disappeared. The stomach contained about two ounces of green vegetable matter, which had an acid reaction—it had obviously undergone fermentation. Although examined within two hours of death, no odour of nicotina or tobacco could be perceived by four persons who were present. This led to the supposition that no part of the drop of alkaloid which had destroyed life could have reached the stomach. The stomach and its contents were treated by Orfila's process,

as elsewhere described (p. 350), with the result that a small quantity of nicotina was separated, possessing the odour and properties assigned to this alkaloid.

The half ounce of blood similarly treated also yielded nicotina in sufficient quantity to allow of the bare inference of its presence. The odour of the separated alkaloid was masked by some other organic principle. Some blood of an animal not poisoned by nicotina was submitted to all the steps of the analysis, with negative results. The liver, weighing two ounces, and the heart and lungs together, were separately examined by the same process, but nicotina was not detected in the tissues of these organs. The tongue, palate, and soft parts of the mouth, were similarly treated after a week. The membrane of the tongue was softened and readily peeled off; this effect was probably partly due to putrefaction, as one drop of the alkaloid would not have been sufficient to cause such local changes. In these parts, nicotina was distinctly present. A sufficient quantity was separated in a pure state, not only to lead to the recognition of the odour, but to allow of the application of all the characteristic tests.

Hence it follows that, in poisoning by this alkaloid, even when the quantity remaining in the body is small, it admits of detection in the stomach and in the blood, but not always in the tissues. Of the single drop administered to the animal, a portion had clearly escaped with the frothy mucus and saliva issuing from the mouth. A minute quantity had passed into the stomach, and was diffused through a large quantity of food, while a trace was detected in the blood; but the largest quantity was found in the parts to which the poison had been directly applied, and which it had no doubt penetrated by imbibition. The results do not show that nicotina is not deposited in the viscera in cases of poisoning by it, but simply, when the quantity is small and death is rapid, that none may be found.

Pathological effects of Nicotina. — The action of this poison upon animals has been lately investigated by M. Claude Bernard.[1] His experiments show that mammalia,

[1] 'Leçons sur les Effets des Substances Toxiques et Médicamentensis,' &c. Paris 1857, p. 397.

birds and reptiles, are destroyed by nicotina under similar symptoms; and that whether applied to the alimentary canal, to a wound in the skin, or to the mucous membrane of the conjunctiva, its rapidly fatal effects are equally manifested. The arterial capillary system appears to be specially affected by the poison, through the medium of the sympathetic nerve. The circulation is here arrested, while the heart continues to pulsate. The veins are full, but they no longer convey the blood onwards. Nicotina appears to affect the nervous system of organic life, just as strychnia affects the nervous system of animal life, and convulsions in either case are among the most prominent symptoms. According to this view the influence of the sympathetic nerve is specially manifested on the vascular capillary system.

Nicotina, like prussic acid, is a compound of carbon, nitrogen, and hydrogen. It contains no oxygen. Its formula is C_{10} H_7 N. When exposed to air and light it undergoes a chemical change, and acquires a brown colour; its energy as a poison is thereby reduced. Bernard states that he found the *modus operandi* of the partially decomposed poison to be different from that of pure nicotina. The functions of the heart and lungs were directly affected by it; while the pure poison chiefly spent its physiological action on the capillary circulation. He also found that the perfectly pure nicotina produced tetanie rigidity of the limbs. These results may explain the different views which have been entertained of the mode in which nicotina operates. One set of experimentalists have arrived at the conclusion that it acted exclusively on the muscular system, while another set have contended that the circulation alone was directly affected. The degree of purity of the nicotina employed may, in some measure, account for these differences.

Convulsions are not a necessary attendant on this form of poisoning. There were none in the case of M. W—. They were observed in the experiment on a rabbit, but they were of a clonic, in place of a tetanic character. The temporary production of opisthotonos, however, proves that the spinal marrow was affected by the poison. The effects produced on the rabbit show the fallacy of relying upon the symptoms caused in animals as evidence of their character and course in the human subject.

It is evident from the case which is the subject of this

paper, as well as from the experiment on the rabbit (page 355), that nicotina produces changes in the blood. The microscope shows no appreciable physical differences; but the colour and consistency of this liquid are entirely changed. The whole of the blood, arterial and venous, acquires a purple-black colour, and the fibrine appears to be dissolved or broken up. Is it to be inferred from its chemical constitution that nicotina completely deoxidizes the blood with the rapidity with which it deoxidizes the solution of permanganate of potash, and that death is the immediate consequence of this universal deoxidation of the vital fluid? When exposed to air it reabsorbs oxygen to a slight extent, and acquires a ruddy hue. These facts may theoretically account for the rapid action of this poison on the body; but in addition to this mode of action, it appears to operate by causing a complete stagnation of the altered blood in the overfilled capillaries. In the case of M. W—. the appearance of the various organs, as a result of capillary congestion, was such as I have never before seen. They appeared as if they had been dyed with a deep purple black dye. This condition, it must be remembered, is the result of the action of a poison in a *few minutes*—a period just sufficient for its circulation throughout the body. In the experiment on the rabbit the heart continued to beat, as in asphyxia, for a short time after all other vital actions had ceased; and this fact, viewed in connexion with the condition of the capillary system after death, appears to show that there is some foundation for the theoretical view of Bernard, namely, that this powerful poison destroys life by arresting the circulation from the circumference to the centre.

LIST

OF

GENTLEMEN EDUCATED AT GUY'S HOSPITAL

WHO HAVE PASSED THE

EXAMINATIONS OF THE SEVERAL UNIVERSITIES, COLLEGES, &c. &c.,

Since September, 1857.

University of London.

DOCTOR OF MEDICINE.

Thomas Edwin Burton Brown.

SECOND EXAMINATION FOR BACHELOR OF MEDICINE.

Uriah Perrin Brodribb. | Samuel Giles.
Frederick Moon.

FIRST EXAMINATION FOR BACHELOR OF MEDICINE.

George Haines Attwell.

MATRICULATION EXAMINATION.

Jno. Thomas Mercer.

University of St. Andrew's.

James Palfrey. | Henry G. Knaggs.

East India Company's Service.

BY EXAMINATION.

Nathaniel Hopkins.
H. C. Cutcliffe.
* T. E. Burton Brown, M.D.
** John Thomas Mackenzie, M.B.

* Placed first in order of merit in list of successful candidates.
** Placed second in order of merit in list of successful candidates.

Royal College of Surgeons of England.

MEMBERS BY EXAMINATION.

NOVEMBER.

C. T. Kelland.

DECEMBER.

Nicholas F. Hele.
W. S. Granger.
Charles Longmore.
William Lynes.

JANUARY, 1858.

A. D'O. Brooks.
W. Ellis.
J. M. Beaumont.
J. Emptage Moore.

MARCH.

Edwin Worts.
Richard T. G. Catton.
R. W. Berkeley.
John Rand.
W. H. P. Dakers.
A. E. Ecroyd.
Edmund Heginbotham.
S. G. Smith.
James Broad.
William Hickman.
J. Bowes.

APRIL.

C. V. S. Bennett.
Thomas Joyce.
W. S. Thomas.
Enoch Robinson.
Edward Lynes.
Henry G. Sadler.
W. Wilkins.
Richard Jones.
W. A. Summers.
George M. Bacon.
John Crew.
G. W. Roberts.
W. Holmes.
J. H. Jenvey.
J. W. Johnstone.
Paul Henry Stokoe.

MAY.

James Neale Earle.
J. Nelson Cregeen.
R. Innes Nesbitt.
Arthur B. Ewen.
Arthur E. Durham.
J. Cheesman.
Walter Moxon.

JUNE.

W. B. Babbage.
R. C. S. Stocker.
J. F. Ashby.

JULY.

R. O. Oliver.
T. R. S. Hooper.
R. S. Newington.
H. W. Haigh.

AUGUST.

George Winstanley.
B. A. Brickwell.
J. T. Pattisson.
A. E. Bartlett.
E. H. Marshall.
Robert J. Rogers.
George F. Spry.

FELLOWS BY EXAMINATION.

H. C. Cutcliffe.
R. H. Moon.

Licentiates in Midwifery.

Francis E. Carey.
Chas. T. Kelland.
G. M. Bacon.
William Venour.
William Lynes.
John Rand.
John Bowes.
A. B. Ewen.
R. W. Berkeley.
Griffith W. Roberts.
J. J. Beer.
James Broad.
Enoch Robinson.
E. Heginbotham.
B. C. Peele.
J. N. Earle.
A. D'Oyley Brooks.
J. M. Beaumont.
Robert Hicks.

Licentiates of the Apothecaries' Society.

AUGUST, 1857.

Joseph Littlewood.

SEPTEMBER.

John Meaburn Bright.

OCTOBER.

Henry Cooper Biddle.

NOVEMBER.

George T. Jepson.

DECEMBER.

Samuel Giles.

JANUARY, 1858.

George Mackenzie Bacon.
Henry Walker.

FEBRUARY.

Christopher Green.
Richard Taylor.
William Hodges.
Benjamin E. Mason.

MARCH.

William Berry.
Edward Lynes.
Robert J. Rogers.
John Cheesman.
W. T. Sargent.
George F. Spry.

APRIL.

A. E. Bartlett.
Edwin Worts.
Paul H. Stokoe.

MAY.

John Morton Beaumont.
James Palfrey.
Nicholas F. Hele.
Thomas J. Trimnell.

JUNE.

John Crew.
Enoch Robinson.
Arthur B. Ewen.
John Rand.

JULY.

Alexander M. McDougal.
James Broad.
W. Wilkins.
William Venour.
N. P. Blaker.
G. H. Dyer.
E. Heginbotham.
R. N. Ingle.

OBTAINED BOTANICAL PRIZE AWARDED BY THE APOTHECARIES' SOCIETY.

Charles Hilton Fagge.

GENTLEMEN WHO HAVE HELD THE APPOINTMENT OF HOUSE-SURGEON.

Robert Hicks.
William Venour.

GENTLEMEN APPOINTED DRESSERS SINCE OCTOBER, 1857.

John M. Beaumont.
John E. Moore.
William Hodges.
A. E. Bartlett.
E. H. Galton.
C. Longmore.
G. M. Bacon.
James Bankart.
Thomas Joyce.
Arthur E. Durham.
Enoch Robinson.
John Crew.
G. F. Spry.
H. Sadler.
John Rand.
R. J. Rogers.
Sidney Smith.
J. Cheesman.
Joseph Ashby.
M. A. Adams.
Walter Moxon.
W. S. Thomas.
C. V. S. Bennett.
George Owen.
John Adcock.

DRESSERS TO THE ASSISTANT-SURGEONS.

C. V. S. Bennett.
R. J. Rogers.
J. Cheesman.
Joseph Ashby.
Arthur B. Ewen.
Edward Stilwell.
P. Henry Stokoe.
G. Roberts.
A. E. Durham.
G. W. Martin.
John Jones.
Christopher Green
William S. Thomas.
M. A. Adams.
R. Greenwood.
G. F. Spry.
George Owen.
Alfred E. Ecroyd.
James Curtis Bird.
Octavius Shepherd.
George F. Farr.
John Candy.
J. B. Tuck.
Bransby Brooks.
A. A. Kennedy.
James Palfrey, M.D.
J. G. Terry.
Alfred W. A. Evans.
Humphrey Williams.
Alfred Hopkins.
John Wilson.

DRESSERS IN THE OPHTHALMIC WARDS.

R. W. Berkeley
Robert J. Nesbitt.
Richard Owen Olliver.
George Owen.
C. V. S. Bennett.
N. Greenwood.
Bransby Brooks.
John C. Gooding.

GENTLEMEN APPOINTED CLINICAL CLERKS.

Winter Session, 1857-8.

James Bankart.
Richard W. Berkeley.
R. T. G. Catton.
John Crew.
Thomas Joyce.
Enoch Robinson.
John Rand.
Edmund Heginbotham.
Charles Swaby Smith.
Paul Henry Stokoe.
G. F. Spry.
R. J. Rogers.

Summer Session, 1858.

Robert James Nesbitt.
C. Longmore.
R. Ingle.
N. Greenwood.
John Callender Gooding.
C. Gayleard.

GENTLEMEN APPOINTED TO CONDUCT THE POST-MORTEM EXAMINATION.

Edmund Heginbotham.
R. W. Berkeley.
John Bowes.
J. W. Martin.
William S. Thomas.
Humphrey Williams
Arthur E. Durham.
Sidney G. Smith.
William Sadler.
John C. Gooding.
E. Charlton.
M. A. Adams.

RESIDENT OBSTETRIC CLERKS.

SEPTEMBER, 1857.

John Morton Beaumont . . Senior Clerk.
Francis Edward Carey . . Junior Clerk.

OCTOBER.

Francis Edward Carey . .	Senior Clerk.
Robert Hicks . . .	Junior Clerk.

NOVEMBER.

Robert Hicks . . .	Senior Clerk.
J. E. O'Reilly . . .	Junior Clerk.

DECEMBER.

J. E. O'Reilly . . .	Senior Clerk.
George Calvert . . .	Junior Clerk.

JANUARY, 1858.

George Calvert . . .	Senior Clerk.
Alexander Mason McDougal. .	Junior Clerk.

FEBRUARY.

Alexander Mason McDougal .	Senior Clerk.
William Granger . . .	Junior Clerk.

MARCH.

William Granger . . .	Senior Clerk.
E. H. Galton . . .	Junior Clerk.

APRIL.

E. H. Galton . . .	Senior Clerk.
James Emptage Moore . .	Junior Clerk.

MAY.

James Emptage Moore . .	Senior Clerk.
James Broad . . .	Junior Clerk.

JUNE.

James Broad . . .	Senior Clerk.
Christopher Green . . .	Junior Clerk.

JULY.

Christopher Green . . .	Senior Clerk.
John Crew	Junior Clerk.

AUGUST.

John Crew	Senior Clerk.
Enoch Robinson . . .	Junior Clerk.

NUMBER OF CASES OF LABOUR ATTENDED DURING 1857-8.

September, 1857 . .	135
October ,, . .	148
November ,, . .	130
December ,, . .	162
January, 1858 . . .	180
February ,, . . .	149
March ,, . . .	133
April ,, . . .	135
May ,, . . .	121
June ,, . . .	105
July ,, . . .	113
August ,, . . .	123
Total . .	1634

HONORARY OBSTETRIC CERTIFICATES

Awarded since October, 1857, for attending above 100 cases during Twelve Months.

A. M. McDougal.
N. Greenwood.
J. S. Benson
J. B. Tuck.
J. H. Galton.
J. Candy.

GUY'S.

1858-9.

THE MEDICAL SESSION

COMMENCES ON THE FIRST OF OCTOBER.

The Introductory Address will be given by Thomas Turner, Esq., Treasurer, on Friday, the First of October, at Two o'clock.

Gentlemen desirous of becoming Students must produce satisfactory testimony as to their Education and Conduct; they are required to pay £40 for the first year, £40 for the second year, and £10 for every succeeding year of attendance. One payment of £100 entitles a Student to a perpetual Ticket.

The Payment for the year admits to the Lectures, Practice, and all the privileges of a Student for that year only.

Clinical Clerks, Dressers, Ward Clerks, Dressers' Reporters, Obstetric Residents, and Dressers in the Eye Wards, are selected according to merit from those Students who have attended a second year. A Resident House-Surgeon is appointed every six months from those Students who have obtained the College Diploma.

Every Student is required to conform to the Rules and Regulations for the internal management of the Hospital.

The privileges of a Student will be withdrawn in the event of neglect or misconduct.

Certificates will not be given for Lectures, and Practice, unless duly attended.

The Christmas Recess commences December 24th. The Lectures are resumed January 6th. The Winter Session terminates March 31st. The Summer Course commences May 1st, and concludes July 31st.

MEDICAL OFFICERS.

Consulting Physician.—Richard Bright, M.D., F.R.S.

Physicians.—Thomas Addison, M.D.; G. H. Barlow, M.D.; H. M. Hughes, M.D.; Owen Rees, M.D., F.R.S.

Assistant Physicians.—W. W. Gull, M.D.; S. O. Habershon, M.D.; S. Wilks, M.D.

Surgeons.—EDWARD COCK, ESQ.; J. HILTON, ESQ., F.R.S.; J. BIRKETT, ESQ.

Assistant Surgeons.—ALFRED POLAND, ESQ.; J. COOPER FORSTER, ESQ.; T. BRYANT, ESQ.

Obstetric Physicians.—J. C. W. LEVER, M.D.; HENRY OLDHAM, M.D.

Surgeon Dentist. — T. BELL, ESQ., F.R.S. and PRES. L.S.; J. SALTER, ESQ.

Surgeon of the Eye Infirmary.—JOHN F. FRANCE, ESQ.

Apothecary.—JAMES STOCKER, ESQ.

LECTURES, &c.

WINTER COURSES.

Medicine.—DR. OWEN REES and DR. GULL, Mondays, Wednesdays, and Fridays, at half-past three.

Clinical Medicine.—DR. ADDISON, DR. BARLOW, DR. HUGHES, and DR. OWEN REES.

Surgery.—MR. HILTON and MR. BIRKETT, Tuesdays, Thursdays, and Saturdays, at half-past three.

Clinical Surgery.—MR. COCK, MR. HILTON, and MR. BIRKETT.

Anatomy, Descriptive and Surgical.—MR. POLAND and MR. COOPER FORSTER, Mondays, Tuesdays, Thursdays, Fridays, and Saturdays, at Nine.

Physiology and Microscopical Anatomy.— DR. PAVY, Tuesdays, Thursdays, and Saturdays, at twelve.

Demonstrations on Anatomy.—MR. MAUNDER, and MR. DURHAM, daily.

Demonstrations on Morbid Anatomy.—DR. WILKS, daily, at half-past two.

Clinical Lectures on Midwifery and Diseases of Women.—DR. LEVER and DR. OLDHAM.

Chemistry.—DR. ALFRED S. TAYLOR, Tuesdays, Thursdays, and Saturdays, at eleven.

Moral Philosophy.—The REV. T. H. BULLOCK, M.A., Chaplain to the Hospital.

Experimental Philosophy.—MR. DURHAM, Wednesdays, at eleven.

Pupils' Physical Society, Saturdays, alternate, at seven in the evening.

The Clinical Wards will open the first week in October.

Lying-in-Charity.—DR. LEVER and DR. OLDHAM.

Curator of the Museum.—DR. WILKS.

SUMMER COURSES.

Demonstrations on Cutaneous Diseases.—DR. ADDISON and DR. GULL, Mondays, at one.

Materia Medica.—Dr. Habershon, Tuesdays, Thursdays, and Saturdays, at three.

Clinical Medicine.—Dr. Gull, Dr. Habershon, and Dr. Wilks.

Clinical Surgery.—Mr. Poland, Mr. J. Cooper Forster, and Mr. Bryant.

Midwifery.—Dr. Lever, and Dr. Oldham, Tuesdays, Wednesdays, Thursdays, Fridays, and Saturdays, at a quarter to nine.

Medical Jurisprudence.—Dr. Alfred S. Taylor, Tuesdays, Thursdays, and Saturdays, at ten.

Ophthalmic Surgery.—Mr. France, Wednesdays and Fridays, at three.

Pathology.—Dr. Wilks, Mondays, at twelve.

Dental Surgery.—Mr. Salter.

Comparative Anatomy.—Dr. Pavy, Wednesdays and Fridays, at twelve.

Botany.—Mr. Johnson, Tuesdays, Thursdays, and Saturdays, at half-past eleven.

Practical Chemistry.—Dr. Odling, Mondays, Wednesdays, and Fridays, ten to one.

The Clinical Wards will be open the first week in May.

Registrars.—Medical, Dr. Whitley; Surgical, Mr. Bryant.

Mr. Maunder and Mr. Durham will assist Pupils in their Studies.

THE LIBRARY, MUSEUMS, AND MODEL ROOMS ARE OPEN DAILY TO THE STUDENTS, FROM NINE O'CLOCK, A.M., TILL FIVE O'CLOCK, P.M.

Mr. Stocker, *Apothecary to Guy's Hospital, is authorized to enter the Names of Students.*

ASTLEY COOPER PRIZE.

The Sixth Triennial Prize of Three Hundred Pounds,

Under the Will of the late SIR ASTLEY COOPER, Bart.,

WILL BE AWARDED TO

THE AUTHOR OF THE BEST ESSAY OR TREATISE

"ON THE STRUCTURE AND USE OF THE THYROID GLAND."

THE Condition annexed by the Testator is, "That the Essays or "Treatises written for such Prize shall contain original experiments "and observations, which shall not have been previously published; "and that such Essays or Treatises shall (as far as the subject shall "admit of) be illustrated by preparations and drawings, which pre- "parations and drawings shall be added to the Museum of Guy's "Hospital, and shall, together with the Work itself, and the sole and "exclusive interest therein and the copyright thereof, become thence- "forth the property of the Hospital, and be transferred as such by "the successful candidate."

It is the will of the Founder that no Physician, or Surgeon, or other officer for the time being, of Guy's Hospital or of St. Thomas's Hospital, nor any person related by blood or affinity to any such Physician, or Surgeon, or other officer for the time being, shall at any time be entitled to claim the Prize; but, with the exception here referred to, this (the Astley Cooper) Prize is open for competition to the whole world.

Candidates are informed that their Essays, either written in the English Language, or, if in a Foreign Language, accompanied by an English translation, must be sent to Guy's Hospital on or before January 1st, 1859, addressed to the Physicians and Surgeons of Guy's Hospital.

Each Essay or Treatise must be distinguished by a Motto, and be accompanied by a sealed envelope containing the Name and Address of the writer. None of the envelopes will be opened, except that which accompanies the successful Treatise. The unsuccessful Essays or Treatises, with the illustrative preparations and drawings, will remain at the Museum of Guy's Hospital until claimed by the respective writers or their agents.